APPENDIX A – 1998 OUTFALL INSPECTIONS CONDITION AND MAINTENANCE STUDY

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THE CITY OF WINNIPEG • VILLE DE WINNIPEG
WATER AND WASTE DEPARTMENT • SERVICE DES EAUX ET DÉCHETS

T.P.

CITY OF WINNIPEG

OUTFALL CONDITION AND MAINTENANCE STUDY

FINAL REPORT

August, 1998

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August 27, 1998

96-107-12

City of Winnipeg
Water and Waste Department
1500 Plessis Road
Winnipeg, Manitoba
R2L 5G6

ATTENTION: Ron Amann C.E.T.
Project Manager

RE: Outfall Condition and Maintenance Study
Final Report and Database Manual

Dear Mr. Amann:

Please find enclosed 11 copies of the final report for the Outfall Condition and Maintenance Study, and 10 copies of the Database Manual. The report and manual include the findings and results of the study performed over the last two years. We have addressed the comments and concerns which were identified from the draft report, and have incorporated them into the final version.

At this time, KGS Group would like to extend its appreciation and thanks to the Steering Committee members and the many WWD personnel whose assistance during the course of the study was extremely valuable. Particular thanks is extended to the branches of the WWD including: Project Management; Design and Contracts; Drafting and Graphic Services; Information Systems; Local Services (East, North and South Areas); and Regional Operations. With the assistance of the WWD, we believe that the results of the study will provide the City with a superior planning tool for future budgeting of capital and required operation and maintenance tasks.

Following the submission of this final report, KGS Group will provide the WWD with the transfer of the information management system, the photo library and the list of discrepancies found between observed data and that contained in LBIS.

We are looking forward to providing the Department with continued engineering services for the implementation of the proposed improvements. If you have any further questions or concerns, please do not hesitate to call.

Yours very truly,

Roy Houston

Roy J. Houston, P.Eng.
Municipal Project Manager

PROVINCE OF MANITOBA
R. J. HOUSTON
Aug 28/98
REGISTERED ENGINEER

RJH/md

enclosure:

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

In 1996, KGS Group was commissioned to perform a comprehensive study to assess the existing condition and the required maintenance for all the outfalls within the City of Winnipeg under the responsibility of the Water and Waste Department (WWD). The enclosed report documents the findings of the study which included a detailed inventory review; inspection program; database development; condition assessment; estimated costs for capital upgrades and required maintenance over a five year planning period.

The inventory review revealed approximately 387 outfalls within the city limits, of which, 350 fall under the responsibility of the WWD and 37 were listed as privately owned. These outfalls were determined to be under the jurisdiction of other municipal or provincial departments, the University of Manitoba or private industry and residences. All attempts were made to locate outfalls identified in previous studies, however, 12 outfalls were not included in the inventory as they were either abandoned or not found, even with the aid of WWD personnel. A complete set of inventory drawings was produced and is included with this report. Digital and full size mylar copies were also forwarded to the WWD.

A comparison was made between the information gathered during the inventory review and existing information contained in the City's Land Based Information System (LBIS). Some discrepancies were noted and reported to the WWD. A detailed list of discrepancies was forwarded as a separate document to the City to enable the WWD to update LBIS and make it consistent with what was found during the inventory review.

To provide a means of assessing the outfalls a detailed inspection program was devised which focused upon the structural aspects of the pipe, the geotechnical bank conditions, and the stream's hydraulic conditions at the pipe. All three aspects were deemed equally important, and if even one of the conditions was found to be in a failed state, it was determined that the outfall was in a failed state and needed to be repaired. From this a condition rating system was devised. Originally KGS Group developed a six point rating system, the ratings were subsequently revised to reflect a 5 point system. A failed outfall was assigned a rating of 5, and a completely satisfactory outfall was assigned a rating of 1. Three ratings were given to each outfall inspected based upon the structural, geotechnical and stream conditions noted at the time of the inspection. KGS Group provided a standard inspection form and rating guidelines to the WWD for use in future inspections and assessments.

Due to high river levels and above normal snow accumulations, KGS Group was forced to complete the inspection over two "low water" seasons. During Phase 1 (1996-97) 121 outfalls were inspected. Additionally, 9 outfalls less than 300 millimetres in diameter and 7 private outfalls were inspected during Phase 1, after which, KGS Group was instructed not to inspect outfalls in these two categories. During the low season of the fall of 1997, 77 outfalls were internally inspected for structural assessment. Inspections were hampered again by high water levels and 77 outfalls were unable to be accessed for inspection. The majority of the access problems were due to submerged conditions at the outfall. A total of 256 outfalls located from the banks were assessed for the geotechnical and hydraulic site conditions, and rated accordingly. In summary, approximately 71 percent of the outfalls that KGS Group was directed to assess were inspected internally for structural conditions.

As part of the Outfall Condition and Maintenance Study, KGS Group developed a computerized information management system (IMS), or database, for all known sewer outfalls within the City of Winnipeg. The database provides a comprehensive record of inventory and inspection information gathered by KGS Group for the outfalls. The database is to be used as an operational tool, and as a means of storing and retrieving the outfall condition information collected. As well, the IMS can be used to facilitate historical tracking of data for inspection and maintenance planning for each outfall. The IMS is programmed with three main modules for entering data; updating the data with new or revised information; and a search module for easy database query. Submitted as a separate document to this report is a database manual explaining the use and structure of the IMS.

All inspection details and condition ratings were entered into the database. It was found that the distribution of ratings among the 5 categories was fairly even. Of the failed outfalls, the majority were determined to be caused by a structural failure of the pipe, and nine outfalls had a failed condition in two or three of the categories (structural, geotechnical and stream). It was determined that approximately 66 percent of the structural failures were found in outfalls that were part of the land drainage system. The smaller number of geotechnical and stream failures was attributed to the outfall reconstruction program, which provided for upgraded bank and erosion protection works in areas adjacent to rehabilitated outfalls.

An assessment of the required rehabilitation works was performed. Approximately 50 outfalls require capital upgrades due to structural failures. Most were in a failed state requiring total replacement of the outfall. A priority ranking system was developed based upon the consequences of total failure of the outfall. Higher risks were assigned to flood pump discharge outfalls than land drainage system outfalls. Larger outfalls were associated with larger services areas, therefore were also given a higher priority. The total estimated cost of the associated repairs was $2,138,000.00. This figure includes the replacement cost for 41 outfall pipes plus the costs of repairing small sections ("spot" or internal repairs) on 9 other outfalls. The figure also includes cost for replacing failed outfalls which are currently under study for sewer relief or other major infrastructure projects. In addition, an estimate was made for any associated erosion protection measures necessary to ensure a reasonable life span of rehabilitated outfalls. A total of $565,000.00 was estimated for those outfalls which require riprap protection at the outlet. The total estimated cost for the required capital upgrades is $2,703,000.00.

A methodology for an economic analysis to compare rehabilitation alternatives of outfalls on unstable banks was developed by KGS Group, and reviewed by WWD, during the study. The methodology compares two scenarios in which the justification for bank stabilization works, as opposed to rehabilitating the outfall pipes after a recurrence of a bank failure, is assessed. The first scenario considered that the consequence of bank failure is limited to the loss of the outfall, and there is no other significant economic impact such as flooding upstream due the pipe failure. The

Additional losses beyond the direct damage to the outfall could include the loss of a flood pump station, and subsequent basement flooding upstream, and/or other important infrastructure works such as a street. Two outfalls were identified during the study to have failed because of their location on an unstable bank. The economic analysis determined that the bank stabilization measures were not justified when considering the economics directly related to the outfall pipes. At another outfall location, the City agreed to stabilize the river bank adjacent to the outfall by cost sharing the project with adjacent land owners. It was recommended that this scenario be pursued at other locations to justify costly bank stabilization works. Each case is unique, and the cost sharing agreement would have to be negotiated independently based upon such factors as adjacent land use, and the requirements for the stabilization.

The study also determined the requirements for continued outfall operation and maintenance (O&M). Recommendations and cost estimates were formulated to address the requirements for erosion protection maintenance (riprap repairs); ice damage repairs; cleansing of pipes subject to sediment buildup; and on going inspections. Estimates were based upon recent experience and discussion with local contractors. Estimated costs for erosion protection maintenance amounted to $97,500.00. Ice damage repairs were separated into to categories and major repairs amounted to $10,500.00 while minor repairs were estimated to be $19,000.00. Sediment buildup maintenance was also categorized as being either major or minor. The estimated costs were $127,000.00 and $87,000.00 respectively. Future inspection costs were also determined based upon the costs incurred during the study, and were estimated to be $181,000.00. A contingency of approximately $25,000.00 should be carried to account for extra costs associated with dewatering outfall pipes (<1200 mm diameter) that a normally submerged. Larger pipes which are normally submerged would have to be assessed individually before determining a methodology and cost for inspection. The total estimated O&M costs for the above items is $552,000.00.

Based upon the total estimated costs for capital upgrades and recommended O&M, a five year plan was devised to phase the work and distribute the expenditures. The WWD has allocated $552,000.00 per year for capital upgrades which is adequate based upon the results of the study and estimated costs. As well, it was recommended that a $100,000.00 per year O&M budget be maintained to address O&M requirements identified in the study. This budget is currently under review by the WWD.

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Introduction

1.0 INTRODUCTION

The operation and maintenance of the sewer outfalls along the Red and Assiniboine River and the tributary streams within the City of Winnipeg are the responsibility of the Water and Waste Department (WWD). Since assuming jurisdiction over these outfalls in 1995, separate outfall inventories have been conducted on the Red and Assiniboine River and on the tributary streams. This database is essentially complete. The Water and Waste Department, however, does not have an inventory which adequately defines the condition and maintenance requirements at the outfalls.

KGS Group was retained to perform the "Outfall Condition and Maintenance Study" in 1996. The study was commissioned to provide the WWD with a comprehensive and thorough review of the condition of all sewer outfalls within the department's jurisdiction. The scope of the study consisted of identifying the outfalls, determining the condition of each by physical and closed circuit television inspection, documentation of the resulting information within an operational database, and providing recommendations for necessary rehabilitation and/or maintenance.

Of those outfalls scheduled to be inspected, approximately 70 percent were completed. The remainder of outfalls were not inspected primarily due to submergence of the outlet for reasons of design or high water/ice levels. Regardless of the inspection status, all outfalls that were identified during the inventory review are included in the database.

The following report summarizes the findings, conclusions and recommendations of the study. A comprehensive review of the outfall inventory was completed and is discussed in Section 2.0. The link between the outfall inventory and the City's Land Based Information System (LBIS) is provided in Section 3.0. The inspection methodology and results of the inspections are given in Section 4.0. A description of the Information Management System (IMS) is given in Section 5.0 while Section 6.0 provides commentary on the assessed condition of those outfalls inspected. Section 7.0 gives details in regards to recommended repairs and the associated estimated costs for the necessary capital upgrades. Similarly, Section 8.0 describes the operation and maintenance work required for the outfalls. Estimated costs are provided. Section 9.0 contains details about phasing the repairs and maintenance over a five year period. Finally, Section 10.0 lists the general conclusions and recommendations resulting from the study.

SECTION 2.0
Inventory Review

2.0 INVENTORY REVIEW

An important objective of the outfall condition and maintenance study was to determine and document an accurate inventory of all existing outfalls. The inventory was necessary to confirm, update and/or revise the existing collection of outfall information. The confirmation of the outfall inventory included all the outfalls known to be under the responsibility of the Water and Waste Department (WWD), and those under the responsibility of others. Those outfalls not under the direct responsibility of the WWD were designated private outfalls. Private outfalls included outfalls under the responsibility of the Parks & Recreation Department, the University of Manitoba, the Manitoba Department of Highways as well as industrial, commercial and private sectors.

The inventory assessment was initiated by a comprehensive review of all relevant data sources provided by the city including:

- River and Tributary Stream Outfall Inventory Drawings (prepared by Alex Kelly for the City of Winnipeg, 1991);
- Land Based Information System (LBIS) data;
- WWD personnel;
- "As-built" Drawings and Atlas Sheets;
- Rivers and Streams - Record Summary Report

A base inventory list was prepared from the information found on the River and Tributary Stream Outfall Inventory Drawings which included information on each outfall such as, size, type and material. This inventory was then checked against the information contained in the LBIS database. The City of Winnipeg forwarded electronic file copies of extracted outfall data from the LBIS. Working drawings were produced from these files, and compared to the information in the existing inventory. The base inventory was then modified or confirmed by available "as-built" drawings and/or by field investigations aided by WWD personnel. Table 2.1 lists the outfalls for which "as-built" drawings were used to confirm the inventory information. Following the review, discrepancies between this data and the LBIS data were reported back to the client to enable it to update the LBIS system as discussed in Section 3.0. Additional relevant information that was found through a search of the Rivers and Streams Record Summary Report was also incorporated into the inventory as necessary.

Based upon the review of the existing data and field investigation, the outfall inventory was revised and updated by KGS Group. In addition, the River and Tributary Stream Outfall Inventory Drawings were revised and updated based on the results of the inventory review. In conjunction with the revised drawings, a naming convention was adapted which was agreed upon by the Steering Committee and others involved in outfall maintenance activities. The revised names of all outfalls was necessary to provide a unique name for each outfall, which could be used by all levels and sections within the WWD. All attempts were made to make the revised names of flood pumping station outfalls consistent with those in the flood pumping manual. The revised names for all outfalls appear on the River and Tributary Stream Outfall Inventory Drawings, and are used consistently with the associated outfall identification numbers (Outfall ID No.) throughout the study and database. A complete set of the drawings is included in Appendix A. The text font used on the drawings was made larger to allow for easier reading of 11" x 17" Drawings.

A total of 387 outfalls were identified during the inventory documentation process. Table 2.2, provides a listing of the number outfalls categorized by owner, size and stream. Of the total number of outfalls identified, KGS Group was directed to inspect only those outfalls owned by the city which were larger than 300 mm in diameter. The inspections also excluded the ditches and channels. Based upon this assessment criteria the total number outfalls to be inspected was 259 as outlined in Table 2.2. The discussion of the inspection methodology is presented in Section 4.0.

Ditches and channels were included in the inventory as was the case in previous studies. Ditches were considered to be significant drainage ditches that discharged into one of the named streams (ie., Red River, Assiniboine River, Bunn's Creek, etc.). The ditches usually entered the stream via, a drop structure or riprap controlled outlet for erosion protection. Channels were considered to be the major tributary to the named streams. For example, where Omand's Creek enters the Assiniboine River the outfall of Omand's Creek (AS-73) is identified as a channel.

As can be seen in Table 2.2, four of the outfalls, namely: RR72 - Syndicate, RR70.1, RR70.2 and RR70.3 - Watt Street are identified as connector pipes. These pipes are part of the outfall structure, but do not discharge directly into a receiving water body. They are intermediate pipes between the discharge pipe at the outlet (ie., RR71 and RR70), and the first structure (manhole, gate chamber, etc.,). The terms of reference for the inspections defined that an outfall was considered to be the pipe or pipes from the outlet at the river to the first structure upstream. Therefore, these connector pipes were included in the inventory and inspections.

Twelve [12] outfalls which were previously identified on the inventory maps were either abandoned or not found in the field, and are not included in the inventory or database. These 12 outfalls are listed in Table 2.3 below. The outfalls were not included in the database, but the abandoned outfalls are shown on the inventory drawings included in Appendix A. The outfalls were eliminated when they could not be located in the field by KGS Group, with the aid of local sewer and water personnel.

TABLES

Table 2.1 Outfall "As-built" Drawings Used

Outfall ID No.	Name	Year	Drawing Number
RR-44	Mager Dr. FPS	1993	LD-1248
RR-46	Metcalfe Pl.	1992	LD-1144
RR-76	Burrows Ave.	1997	LD-1635
RR-80	St. John's Park	1997 1997	LD-1636 LD-1637
RR-104	Red River Blvd.	1997	LD-1638
RR-106	Summerview Lane	1997	LD-1639
AS-16.1	Raquette St,	1988	WC-1968
AS-23	Dieppe Rd.	1969	372
AS-88	Cornish Avenue	1986	LD-569
AS-99	Mayfair Ave.	1997	4111
SE-53.1	Royalwood Subdivision	1993 1993	HF-4323 HF-4326
SE-58.1	St. Annes Rd.	1996 1997	LD-1654 LD-1655
FL-1	Deacon Reservoir	1996	D-4361
FL-2	Kildare Street	1981 1981	LD-528 LD-528

Table 2.2 - Outfall Inventory Summary

Stream	City Owned					Private	Totals
	≤300	> 300 and < 1200	≥1200	Channels	Ditches	All	
Red River	7	33	60	5	1	13	119
Assiniboine River	23	35	34	4	0	21	117
Seine River	18	31	12	2	1	3	67
Bunns Creek	2	13	9	0	2	0	26
Omand's Creek	21	3	1	1	0	0	26
Sturgeon Creek	2	18	6	0	0	0	26
La Salle River	2	2	0	0	0	0	4
Floodway	0	0	2	0	0	0	2
Totals	75	135	124	12	4	37	387

Notes:
1. RR72 Syndicate is connected to RR71, RR72 was not counted as an outfall in this table, but is included in the database as a connector pipe.
2. RR70.1, RR70.2 and RR70.3 are connected to RR70 - Watt Street. They are not counted as outfalls in this table, but are included in the database as connector pipes.
3. RR56.2 - Pioneer Blvd. is not included because it's a new installation 1997-98.

Table 2.3 - Outfalls not included in the Database

Outfall ID No.#	Name	Type	Size	Comments
RR-28.9	Victoria Crescent	LDS	?	Not Found
RR-29.5	Victoria Crescent	LDS	?	Not Found
RR-56.8	Provencher Blvd.	LDS	?	Not Found
RR-65	Boyle St. FPS	CS	1050	Abandoned
RR-66	Boyle St.	CS	900	Abandoned
RR-97A	Bergen Cut-Off	LDS	?	Abandoned
AS-16	Raquette	WWS	450	Abandoned
AS-84	Arlington Ave.	CS	350	Does Not Exist
AS-96	Assinibione Avenue	LDS	1100	Abandoned
AS-98	The Forks E. of CNR Bridge	CS	1500x1000	Abandoned
OM-27	Sherwin Road	LDS	450	Does Not Exist
OM-28	Notre Dame Ave. W,	LDS	450	Abandoned

SECTION 3.0
LBIS Update

3.0 LAND BASED INFORMATION SYSTEM (LBIS) UPDATE

The inventory review process described in Section 2.0 substantiated or contradicted the existing information contained in the City's Land Based Information System (LBIS). In some cases the information contained in LBIS was incomplete or incorrect. The WWD was informed that some discrepancies exist between LBIS and what has been inventoried. Changing or updating LBIS was not a requirement for the Outfall Condition and Maintenance study. A detailed list of required updates or changes to LBIS was prepared and forwarded separately for the City by KGS Group based upon the comparison of the existing LBIS data with the confirmed inventory data.

During the inventory review KGS Group identified several outfalls that were not recorded in LBIS. This information was forwarded to the WWD. The City added a portion of the missing outfalls to LBIS and provided KGS Group with the updated LBIS drawings and LBIS numbers for the outfalls. Consequently, LBIS number information was updated in the outfall database as described in Section 5.0. To-date several outfalls do not have an LBIS number, and are, therefore, assumed to be missing from LBIS database. Table 3.1 lists the outfalls identified by KGS Group during the inventory review process which do not have an associated LBIS number.

TABLES

Table 3.1 - Outfalls Not Contained in LBIS

Outfall ID No.	Name
RR-11	Radcliffe
RR-34.1	Kingston Row
RR-38	Cockburn St. FPS
RR-39	Cockburn St. Lift Station
RR-52	Marion St.
RR-55	Rue Despins FPD
RR-100	Whellams Lane
AS-1	WEWPCC (outside the perimeter)
AS-6	Barker SPS
AS-7	Caron Park
AS-23.1	Dieppe Rd. LDS
AS-60B	Chataway Blvd.
AS-67A	Route 90 Bridge
AS-76	Ash St. FPS
AS-86B	Maryland St.
AS-95	Assiniboine Ave. FPD
SE-7	Provencher Blvd.
SE-10	Rue Bourgeault
SE-17	Marion St. Bridge
SE-25	Dubuc St.
SE-58.1	St. Annes Rd.
ST-18.1	Hamilton Ave.
OM-10	Velodrome Metre Pit
OM-11	Velodrome
OM-12	Empress St.
OM-21	Empress St.
FL-1	Deacon Reservoir
FL-2	Kildare Ave.

SECTION 4.0 Outfall
Inspections

4.0 OUTFALL INSPECTIONS

4.1 Basis for Condition Assessment

The assessment of the outfall condition was assumed to be based upon three key interrelated aspects which may individually or coincidentally impact an outfall. For the Outfall Condition and Maintenance Study, the following conditions were considered to affect the performance of the outfall:

- The structural system of the outfall pipe - Structural;
- The hydraulic impacts of the stream on the outfall - Hydraulics;
- The stability of the riverbank as it relates to movement of the outfall - Geotechnical.

Other factors which could contribute to unsatisfactory performance include: sediment build-up inside the pipe, and obstructions caused by vegetative growth.

Having identified the key factors influencing the performance of a pipe, an assessment of the condition of the outfall could only be made once the proper information was collected. An inspection program was developed to ensure all data requirements were available when performing a condition assessment. The following data was to be collected during the inspection:

Structural

Physical Condition of the Pipe - A number of physical measurements and observations were taken to assess the physical condition of the pipe as outlined below. When possible the inspection of the outfall pipe was extended from the river bank up to the first structure (gate, weir, manhole, etc.). Physical data collected included:

- Deformation of the pipes (vertical, horizontal and diagonal)
- Cracking of the pipe and crack opening size/location
- Joint separations (opening, offset) and location (crown, base, side)
- Disturbance of invert alignment (upheaval, drop, side movement)
- Evidence of seepage into the pipe
- Loss of soil around pipe annulus, and voids or cavities outside the pipe
- Pipe disturbance caused by soil slumping and shear zones or soil scouring and erosion
- Corroded and pitted metal
- Concrete deterioration

Pipe Alignment - The outfall pipe was visually inspected for noticeable horizontal and vertical movements in the alignment of the pipe. Measurement of horizontal and vertical displacements were taken when possible. Longitudinal pipe deflection (Sag) was also measured where possible. It was originally proposed to survey the outlet invert elevations of all outfalls. However, the WWD requested that this work not be performed at this time. It may be appropriate to review the necessity of measuring the inverts, and perform the work if budgetary constraints allow it.

Ice Damage - Evidence of ice damage was noted, and commented on.

Hydraulic

Hydraulic Restrictions - Conditions which affect the hydraulic capacity of the outfall were noted. These included:

- partial collapse of the pipe due to movement of the pipe or from impact from ice or debris.
- a build up of sediment at the outlet which would cause a restriction to the capacity of the pipe
- severe restriction caused by vegetation growth downstream of the outlet.

Geotechnical

The methodology for the geotechnical assessment of riverbank stability consisted of:

- Detailed on site inspection of bank stability conditions by experienced geotechnical engineers.
- Review of Winnipeg Waterways Authority records of previous bank works constructed at or adjacent to each outfall.
- Air photo review of bank stability conditions at all outfalls.

On site inspections were not possible in the winter of 1996-1997 due to early and very heavy snowfalls, which masked any and all relevant ground features, even before award of the contract. All bank inspections were completed in October and November 1997, during and after the annual fall drawdown.

Bank stability features which were recorded on site included:

- Bank height
- Bank positions with respect to the river meander pattern
- Bank slope
- Any and all slope failure features including active or inactive headscarps, tension cracking in the bank surface, and humocky topography
- Erosion features such as toe scouring or undercutting of the bank
- The presence or condition of any existing bank protection works.
- The type of vegetation cover
- The presence of any existing slope stability instrumentation.

Inspection of existing Winnipeg Waterways Authority records for records of previous bank works in the vicinity of the outfall provided a valuable indication of which sections of riverbank have been historically stable or unstable. The Authority maintains records of all bank works completed under its jurisdiction since 1950. These records were used as a planning tool prior to initiating the on-site inspections.

Comprehensive air photo coverage of the riverbank conditions was obtained by the Winnipeg Waterways Authority in 1988 and 1992, each time during the winter drawdown period and with no foliage on the trees. The photos are an invaluable indicator of potential bank stability problems. Again air photo review was used as a planning tool prior to the on-site inspections.

The geotechnical assessments in this report utilize results from all three components of the methodology, but do rely most heavily on the actual site inspection.

The information obtained in the outfall inspection program was used to rate the condition of all the outfalls. The condition rating system originally developed by KGS Group included a 6 point rating system with a failure condition assigned a rating of 1, and a fully satisfactory condition assigned a rating of 6. The system developed by KGS Group was based upon the Ontario Ministry of Transportation condition rating system for the inspection of bridge and culvert crossings. Initial discussions with the Steering Committee lead to a revision of the rating system to coincide with the rating system being used by the Water and Waste Department for the condition rating of the sewer system network. Consequently, the rating system was revised to a 5 point rating system based upon the WRc[1] method for structurally rating sewer pipes. With the revised condition rating system, the failure condition was assigned a rating of 5, and the fully satisfactory condition was assigned a condition rating of 1.

Since it was recognized that the field inspections would be conducted by a number of different inspection teams, now and in the future, guidelines for rating the condition of an outfall were developed to ensure a consistent approach in obtaining the field data. The guidelines were based upon the ranking system for rating an outfall's structure, stream and riverbank conditions, and are given in Appendix B.

An overall condition rating for the outfalls was also developed. The criteria established for the overall rating is based upon the worst condition rating of the performance criteria considered. For example, if the structural condition is assigned a rating of 5, the stream condition is assigned a rating of 3, and the riverbank condition is given a rating of 3, then the overall rating would be

[1] Manual of Sewer Condition Classification, WRc, August 1993

assessed at 5 based on the worst condition rating found during the inspection. The procedure assumes that each of the performance categories (structure, geotechnical and stream) are equally important to the overall condition of the pipes performance. If any one of the categories is found to be at a failure condition, then the outfall is found to be in a failure condition.

4.2 Inspection Forms

An inspection form was developed for the field inspections to reflect the need for consistent data collection during the inspections of the outfalls. A sample form is included in Appendix B, and was used for all inspections performed by KGS Group personnel. As can be seen on the sample form, the following inspection information was included:

Inspection Data:	Inspector's Name; Date of Inspection; Party Members; Air Temperature; Weather Conditions
General Information:	Outfall Name; Location; Owner; Sewer Type; Stream
Physical Information:	Land Based Information System (LBIS) No.; Shape, Diameter (height and/or width); Length; Pipe Material; Invert Elevation; Sag; Grates
Pipe Hydraulics:	Deformation; Ice Damage; Hydraulic Restrictions
Geotechnical:	Bank Height; River Section; Slope; Slump; Erosion; Vegetation; Instrumentation
Condition Rating:	Structure CR; Geotechnical CR; Stream CR, General Comments.

The second page of the form consists of a structure condition crack mapping chart. The mapping was based upon a 12 hour clock position referenced as the ordinate, and the distance from the outfall end of the pipe as the abscissa to reference any cracks, spalling, displaced joints or other anomalies associated with the structural condition of the pipe. All the mapping charts created in the field were then reproduced digitally using AUTOCAD©. Copies are included in Appendix C.

A number of the outfalls between 300 and 1200 mm diameter were inspected by closed circuit televising and recorded on VHS video format. The televised videos were reviewed, notes taken, and transferred directly to the database. A subsequent field survey and geotechnical assessment for all outfalls televised was conducted by KGS Group, and the information was recorded on the inspection forms.

4.3 Inspections

It was originally proposed to have all the outfall inspections performed in one low water season. Typically the rivers and streams through Winnipeg experience lower flows and water levels after the fall "drawdown" when the gates at Lockport are opened (usually mid-October). Upon authorization to proceed, KGS Group initiated the structural inspections of the outfalls. The 1996/97 inspections were hampered, however, by early and record snow falls and high water/ice levels in the Red and Assiniboine Rivers. For this reason, KGS Group was authorized to perform the inspections over two low water seasons.

The outfall inspection program was completed by December 1997. All accessible outfalls were inspected to determine the structural condition of the outfall pipe, and all outfalls greater than 300 mm diameter (as directed by the WWD) were inspected to assess geotechnical and stream conditions. Table 4.1 provides a listing of the number outfalls which were inspected, and categorized by owner, size and stream. A complete listing of all the outfalls inspected is presented by Phase in Appendix D. As can be determined from the table, 75 percent of those outfalls required to be inspected by CCTV (101 of 135) were completed, and 66 percent of those required to be physically inspected (81 of 124) were completed. In total, 71 percent of the outfalls (182 of 259) were inspected. Additionally, 16 outfalls, 9 smaller than 300 mm diameter and 7 designated as privately owned, were also inspected and recorded during the study.

Of those outfalls not inspected during the study, a majority could not be inspected because the outfall pipe was partially or completely submerged. In some cases the submergence was due to above normal water levels, and in others, the outfalls were designed to be submerged, especially those outfalls which are part of the City's land drainage sewer system or on the north side of the Assiniboine River and west of the St. James Bridge. A small portion of the outfalls could not be accessed, due either to their location or type of sewer (ie., treated sewage). Two outfalls were not inspected because of severe sediment/debris build up inside the pipe. Table 4.2 categorizes those outfalls which were not inspected by size, stream and reason for not being inspected. A complete listing of those outfalls not inspected is provided in Appendix E. A prioritized list and methodology for inspecting the remaining outfalls could be developed under the present budget or a future project budget.

In general, the inspections performed consisted of personal - "walk through" - visual inspections for outfalls greater than 1200 mm in diameter, or recorded inspection by closed circuit television (CCTV) for outfalls between 300 and 1200 mm in diameter. All pipes inspected physically or by CCTV were recorded on VHS video format, and photographs (included with the submitted CCTV reports) of distressed areas were taken. The video tapes have been forwarded to the WWD with this report. A complete index of the tapes is provided in Appendix F. All inspected outfalls are listed by tributary and name, and the tape index and recorded time interval (in minutes from the beginning of the tape) are given.

The condition information noted was recorded on the Inspection Forms described in Section 4.2. The visual inspections facilitated an assessment of the outfall pipe's structural condition. As well, the bank conditions and the streams impact on the outlets were inspected and assessed via boat and visual inspection. Throughout the inspection process, WWD personnel assisted KGS Group with opening locked gate chambers and pumping stations, removing outlet grates, and locating manholes. A description of each phase of the inspection process is presented below.

Phase 1 (1996-97)

In November 1996 KGS Group commenced the inspections, which focussed primarily on the outfalls located on the Red and Assiniboine Rivers. A preliminary list of outfalls in poor condition was submitted to the Steering Committee in December, 1996. The most notable, of which, was "RR-15 - Rivergate Dr." which the City reviewed and considered redundant.

A visual inspection of the outfall and bank stability conditions along the Red River within Winnipeg, and on the Assiniboine River downstream (east) of the Maryland Bridge was completed on November 4, 1996. The inspection was performed by Mr. Brian Bodnaruk, P. Eng., Senior Hydraulic Engineer, and Mr. Mark Jamieson, P. Eng., Senior Geotechnical Engineer, of KGS Group in a boat provided by the City of Winnipeg Harbour Master, Joe Pietracci. Shallow water depths did not permit boat passage upstream of the Maryland Bridge. At the time of the inspection, the river was drawn down to its natural winter level (221.5 metres at James Avenue), approximately 1.7 m below the regulated summer river level. Photographs (see Photo Log submitted with this report) and video (submitted to WWD with this report) were taken of the majority of the outfalls to provide a permanent record. The inspection from the river allowed investigation of the shoreline conditions of both the riverbank and the exit of the outfall. Particular attention was given to the riverbank stability and erosion conditions, as well as the condition of the visible portion of the outfall at each location.

The structural inspections for larger pipes was performed by two man inspection teams. One member of the inspection team accessed the outfall pipes via the first upstream manhole or the outlet. The inspector recorded the information on the forms, and the other party member acted as a safety watch.

A total of 121 outfalls were inspected during Phase 1. This included: 65 inspections of outfalls 1200 mm diameter or greater; 40 videotaped inspections of outfalls between 300 and 1200 mm diameter; 9 videotaped inspections of outfalls 300 mm diameter or less; and 7 private outfalls. KGS Group was forced to abandon the "walk through" structural inspections in mid January 1997 due to very large snow accumulations and a winter river level that was approximately 2.0 feet higher than normal.

UniJet Industrial Pipe Services Limited was subcontracted to perform the inspections by CCTV. The outfall pipes were accessed via the first upstream manhole or from the outlet. Upon completing several inspections UniJet forwarded inspection reports and video tapes to KGS Group. The inspection reports and videos were reviewed by KGS Group and the outfalls were rated according to the rating guidelines.

KGS Group discontinued televising outfalls in mid December 1996. This was due to the difficulty in locating the manholes under the large snow accumulation. Even with the combined effort of KGS field staff and City of Winnipeg crews, locating and marking the manhole locations proved to be too difficult. Frozen locks at pumping stations and ice accumulation in pipes were also major problems.

Phase 2 (1997-98)

In September 1997, KGS Group initiated the second phase of the outfall inspection program. An overall inspection of all of the outfalls was performed to determine which were accessible. This included a boat assisted reconnaissance visit by KGS Group geotechnical engineers to all locations of outfalls greater than 300 mm. Photographs were taken from the river of each outfall and its overall bank condition. River bank stability and erosion conditions were assessed and rated according to the guidelines outlined in Section 4.1.

Inspection teams were increased to three members for the "walk through" inspections during the second phase to comply with the Workplace Health and Safety and the City of Winnipeg's Regulations for Confined Space Entry. The inspector would access the outfall, while the other two members remained above ground. While descending down the Manhole, the inspector was connected to a safety tripod. The inspector was required to wear a self contained breathing apparatus, a safety harness, and a "life line" while performing the inspections. The inspector would complete the inspection forms, videotape and photograph the pipe. The second and third members of the team were situated at the pipe outlet and the access manhole while the inspector was in the pipe in case of emergency. The safety equipment used was portable but cumbersome, which slowed the progress of the inspections considerably. With this procedure adopted in the second phase, each crew was only able to inspect two outfalls per day maximum, where during the first phase, a two man crew was able to inspect up to five outfalls in one day.

The remaining 77 outfalls inspected were completed during Phase 2. This included 17 physical inspections of outfalls 1200 mm diameter or greater, and 60 videotaped inspections of outfalls between 300 and 1200 mm diameter. River levels were approximately 1.5 to 2.3 feet higher than normal which prevented further inspection of the outfalls identified as submerged.

Once again UniJet Industrial Pipe Services was subcontracted to televise the outfalls. This work was coordinated by KGS Group, which marked out manhole locations and provided UniJet with a list of outfalls to be inspected. Once completed, inspection reports and videos were reviewed by KGS Group, the outfalls were rated according to the guidelines.

TABLES

Table 4.1 - Summary of Outfalls Inspected

Stream	City Owned			Private	Totals
	≤300	> 300 and < 1200	≥1200	All	
Red River	3	25	48	2	78
Assiniboine River	6	31	21	5	63
Seine River	0	19	3	0	22
Bunns Creek	0	7	4	0	11
Omand's Creek	0	3	0	0	3
Sturgeon Creek	0	14	3	0	17
La Salle River	0	2	0	0	2
Floodway	0	0	2	0	2
Totals	9	101	81	7	198

Notes:1.RR70.1, RR70.2 and RR70.3 are connected to RR70 - Watt St. All are recorded as one outfall in this table.
2.RR72 is connected to RR71 - Syndicate. These pipes are recorded as one outfall in this table.

Table 4.2 - Summary of Outfalls Not Inspected

Stream	Submerged		No Access		Sediment Build-Up		Totals
	> 300 and < 1200	≥1200	> 300 and < 1200	≥1200	> 300 and < 1200	≥1200	
Red River	3	9	4	2	1	1	20
Assiniboine River	2	12	2	1	0	0	17
Seine River	12	9	0	0	0	0	21
Bunns Creek	6	5	0	0	0	0	11
Omand's Creek	0	1	0	0	0	0	1
Sturgeon Creek	3	3	0	0	1	0	7
La Salle River	0	0	0	0	0	0	0
Floodway	0	0	0	0	0	0	0
Totals	26	39	6	3	2	1	77

PROPERTY
OF THE
WATER & WASTE DEPARTMENT
RESOURCE CENTRE
1500 PLESSIS ROAD

SECTION 5.0
Information Management System

SECTION 5.0
Information
Management System

5.0 INFORMATION MANAGEMENT SYSTEM

5.1 General

As part of the Outfall Condition and Maintenance Study, KGS Group developed a computerized information management system (IMS), or database, for all known sewer outfalls within the City of Winnipeg. The database provides a comprehensive record of inventory and inspection information gathered by KGS Group for the outfalls. The database is to be used as an operational tool, and as a means of storing and retrieving the outfall condition information collected. As well, the IMS can be used to facilitate historical tracking of data for inspection and maintenance planning for each outfall. The outfall database is set up with a "user friendly" interface to allow novice computer users a means of entering, updating, searching, displaying and reporting data for each outfall.

Development of the database was completed with input from the Steering Committee. The preferences for the user interface, data to be included in the database, and data presentation was developed during consultations with the Steering Committee. As well, CG&S Consultants were consulted for additional advice on the database development and programming preferences including the data structure.

It was originally proposed to use the *BORLAND PARADOX*® database software because it was being used in a similar study of the City of Winnipeg Aqueduct. However, during the development of the database, *MICROSOFT ACCESS*® was recommended by KGS Group and agreed to by the Water and Waste Department since it was a more familiar tool to the department's personnel.

The IMS was programmed using *MICROSOFT ACCESS 7.0*©. This relational database tool allows development of a full featured user interface, which can be customized to any user preference. Users of the database utilize the convenient forms for manipulating the database, and do not have to work with complex table structures for input or data presentation. The database structure can be customized by an experienced database programmer using the table, form, query and report functions.

5.2 Outfall Database

The outfall database features forms for entering, updating and searching for data. The user is provided access to the underlying data table structure through the "user friendly" forms which are presented in similar manner to the inspections forms. This allows the user to input and update data in a consistent fashion. Searching through the database is also facilitated by allowing the user to specify a number of search criteria. As well, predefined reports can be viewed and printed by the user. A comprehensive and detailed explanation of the database, its tables, forms, reports, and use is included in the database manual which is attached to this report as a separate document. A brief discussion of the major features of the IMS is given below.

The IMS consists of three overall modules, specifically: The Data Entry module, the Data Update module, and the Database Search module. All modules are controlled from a main menu. Data Entry is used for inputting new data for an outfall which has not yet been identified in the database. Data Update is a tool for changing previously entered data or entering new inspection data for an outfall which already exists within the database. The searching tool can be used to find specific outfalls in the database which match given criteria. The Search Utility can be used to identify a set of outfalls, or a particular outfall which may need to be updated. Two reports are available at different stages throughout the search process. Each can be printed for hard copies if the search is successful.

The intent of the IMS is to facilitate the collection of the inspection information for all outfalls through time. The database is organized such that the general information about an outfall, such as the Name, Location, Outfall ID No., Sewer Type, Size, Shape, Material Type etc., remains relatively fixed through time. The specific inspection data information, which is subsequently gathered, is then linked to the more general information. Each inspection is indexed and stored in the database, so that a history of the condition of a particular outfall can be tracked through time. The inspection information is categorized and organized in the IMS in a similar manner to that which appears on the inspection form including the Inspection Party, Pipe Hydraulics, Geotechnical, and the Condition Assessment.

The Outfall Study database can also be linked to the City's Land Based Information System (LBIS) through the LBIS number. For those pipe segments with an associated LBIS number, each can be linked to the LBIS system. Integrating the two systems through this link was not considered as part of this study.

Where possible, tasks were automated to accelerate data entry, and default or "pulldown" lists were presented to the user to maintain consistency in the data. For example, the user is presented with the following list of default choices for Pipe Restrictions:

- Partial collapse of pipe
- Sediment built up in the pipe
- Severe restriction caused by vegetation

As described in Section 2.0, the database submitted to the WWD contains information for 387 different outfalls, of which, 349 fall under the responsibility of the WWD, and 37 are categorized as privately owned outfalls. As indicated in Section 4.0, inspections were completed for approximately 71 percent of the outfalls that were required to be inspected. The inspection and condition assessment information for these outfalls has been entered into the database.

5.3 Outstanding Issues

The database does not have any built-in password security. Authorization for use of the database could be invoked at either the Administrator level and/or the User level. The administrator would have a separate password to use the database, enter data, manipulate the data, forms, reports or tables. The user would have a unique password (ie., many users with one general password). Users would only be able to interact with the database through the forms developed. They would not be able to manipulate the data within specific tables, and they would not be able to change the forms, reports or other database structures. This level of security was recommended to the Steering Committee. It was decided, however, not to implement the security at this time because the personnel responsible for administering and using the database will be responsible for initiating the desired level of security.

The reports generated by the database are generic and have broad scope. The WWD may find it necessary to develop more specific reports from the database after using the IMS and determining its functionality. As stated above, the reports can be tailored to meet any end users needs, and can be created by an experienced programmer familiar with *MICROSOFT ACCESS©*.

SECTION 6.0
Condition
Assessment

6.0 CONDITION ASSESSMENT

As mentioned previously, approximately 182 of the required 259 outfalls under the responsibility of the WWD have been inspected and assessed for their present condition. Of these outfalls 71 have been assigned a failure condition rating of 5. The rating is based upon the structural condition of the pipe, as well as the geotechnical and hydraulic (stream) condition of the bank as discussed in Section 4.0. The ratings have been categorized in Table 6.1 according to the reason for the failure rating and by stream. In some cases, an outfall was assigned a failure rating of 5 for two or more of the categories. For example, "RR-24 - Falconer Bay" was assessed to have failed on all three categories of structure, geotechnical and stream ratings. The table below also lists the number of outfalls with more than one failure rating according to the possible combinations of the three categories (ie., Structure, Geotechnical & Stream - All, Structure & Geotechnical - (1) & (2), Structure & Stream - (1) & (3), Geotechnical & Stream - (2) & (3).

As can be seen in the table the majority of failures occur as a result of structural problems with the pipes. Further analysis of the data, reveals that 56 percent of the failures have occurred in outfalls between 300 and 1200 mm diameter. Table 6.2 categorizes the number of failures by sewer type. As can be seen the majority of the outfalls that have failed are part of the City's land drainage system. These statistics will provide a basis for planning the rehabilitation of the outfalls, which is discussed further in Section 7.0

It is noted that 6 of the 9 outfalls inspected that are less than or equal to 300 mm diameter were found to be in a failed state. This is a significant percentage which may warrant the remaining 65 outfalls in this category to be inspected.

6.1 Structural Condition Ratings

For each of the outfalls that were required to be inspected, structural ratings were assessed according to the guidelines described in Section 4.0. Table 6.3 lists the distribution of structural ratings according to tributary. As can be seen a total of 77 outfalls were unable to be rated for their structural condition as these outfalls were not inspected (see Section 4.0). The ratings were based upon the review of the inspection data collected during the "walk through" and CCTV inspections. The assessments were made according to the information contained on the available structure condition crack mapping charts, notes, and observations made during a review of the video taped inspections.

As can be seen on the table the ratings are distributed throughout the range, but the largest percentage (30%) of the outfalls have been assigned a rating of 5. The majority of the failed outfalls had significant defects throughout the entire length of the outfall. The most common problem was found to be open and displaced joints horizontally and vertically. This condition was often coincidental to sediment buildup and root infiltration. Cracking and pipe deterioration was the second most common problem, and only two outfalls were found to be on the verge of total collapse.

Of the outfalls inspected, 8 had major defects in specific locations only. "Spot" repairs could be performed on these outfalls to remedy the situation without having to totally rehabilitate the entire length of pipe. As well, one outfall was noted as having a failed condition throughout the length of the pipe at the majority of the joints. These joints could be repair internally and extend the life of the outfall without significant capital expenditure. The extent of the failure and nature of the required repair were taken into account when the costs were estimated (see Section 7.0).

For the remaining outfalls not rated 5 structurally, a monitoring program will be established. The program will involve a routine of inspections with higher priority given to outfalls structurally rated 4 than those rated 1. An effective operations and maintenance program would reduce future capital upgrade costs, or at least make more effective and timely use of capital resources. The required operations and maintenance program is discussed in more detail in Section 8.0

6.2 Geotechnical Condition Ratings

Geotechnical condition ratings were assigned each outfall greater than 300 mm in diameter according to the methodology described in Section 4.1. Table 6.4 lists the distribution of geotechnical ratings according to tributary. A total of 256 outfalls have been rated as part of this draft report. The remaining 3 outfalls were not inspected due to submergence of the outlet or problems in locating the outlet.

As shown on Table 6.4, the ratings are skewed to the 1 and 2 ratings, with 75% rated as 1 or 2. The remainder are found as 16.0% rated as a 3, 6.0% rated as 4, and 2% rated as 5. Of those rated 4 or 5, the most common problem was active bank failures and/or significant overall bank erosion.

The low percentage of outfalls with a geotechnical bank rating of 4 or 5 was not expected at the onset of this study. The low percentage is attributed primarily to the outfall reconstruction program implemented by the City of Winnipeg in the 1980's and 1990's, which focussed on the larger diameter outfalls in the worst condition. Many of those outfalls were located on the banks of unstable outside bends where erosion, undercutting, slumping and retrogressive bank movements had undoubtedly contributed to the poor condition of the outfall. In each case, significant bank stabilization works were completed as part of the outfall repair with the result being few outfalls remaining in poor condition (geotechnical rating of 4 or 5) as was reflected by the geotechnical inspection results.

6.3 Stream (Erosion) Condition Ratings

Erosion condition ratings are summarized on Table 6.5. Again the majority of the stream condition ratings, 52 % were ranked as category 1 or 2, 21 % were ranked as category 3, 18 % were ranked as 4, and 8 % were assigned a 5 rating.

The lower percentage of outfalls rated as 4 and 5 is again attributed to the extensive bank works in the 1980's and 1990's constructed around many outfalls on outside bends.

TABLES

Table 6.1 - Summary of Outfalls with Failure Rating

Stream	Structure Only (1)	Geotech. Only (2)	Stream Only (3)	(1) & (2)	(1) & (3)	(2) & (3)	All	Total
Red R.	21	0	5	0	4	1	1	32
Assiniboine R.	20	0	0	0	0	0	0	20
Seine R.	1	2	0	0	0	0	0	3
Bunns Cr.	1	0	3	0	0	0	0	4
Omand's Cr.	1	0	0	1	0	0	0	2
Sturgeon Cr.	1	0	5	0	2	0	0	8
La Salle R.	0	0	0	0	0	0	0	0
Floodway	2	0	0	0	0	0	0	2
Totals	47	2	13	1	6	1	1	71

Table 6.2 Failures of Outfalls by Sewer Type

Sewer Type	Number of Failed Outfalls	Percentage of Total Failed
Land Drainage Sewer	47	66.2
Combined Sewer	20	28.2
Waste Water Sewer Overflow	4	5.6
Totals	71	100

Table 6.3 - Structural Condition Ratings Summary

Stream	Structural Rating						Total
	1	2	3	4	5	Not Rated	
Red R.	16	16	8	7	26	20	93
Assiniboine R.	12	6	9	5	20	17	69
Seine R.	4	7	7	3	1	21	43
Bunns Cr.	4	3	3	0	1	11	22
Omand's Cr.	0	0	0	1	2	1	4
Sturgeon Cr.	1	3	8	2	3	7	24
La Salle R.	0	2	0	0	0	0	2
Floodway	0	0	0	0	2	0	2
Totals	37	37	35	18	55	77	259

Table 6.4 - Geotechnical Condition Ratings Summary

Stream	Geotechnical Rating						Total
	1	2	3	4	5	Not Rated	
Red R.	38	30	17	6	2	1	93
Assiniboine R.	4	54	8	2	0	1	69
Seine R.	12	21	4	4	2	0	43
Bunns Cr.	9	2	9	2	0	0	22
Omand's Cr.	0	3	0	0	1	0	4
Sturgeon Cr.	14	4	3	2	0	1	24
La Salle R.	1	1	0	0	0	0	2
Floodway	1	1	0	0	0	0	2
Totals	79	116	41	16	5	3	259

Table 6.5 - Stream Ratings Summary

Stream	Stream Rating						Total
	1	2	3	4	5	Not Rated	
Red R.	13	11	37	19	11	2	93
Assiniboine R.	29	24	6	9	0	1	69
Seine R.	27	8	4	4	0	0	43
Bunns Cr.	6	5	3	5	3	0	22
Omand's Cr.	0	3	0	1	0	0	4
Sturgeon Cr.	2	3	3	8	7	1	24
La Salle R.	2	0	0	0	0	0	2
Floodway	2	0	0	0	0	0	2
Totals	81	54	53	46	21	4	259

SECTION 7.0
Recommended
Capital Upgrades

7.0 RECOMMENDED CAPITAL UPGRADES

Based upon the assessed conditions for each outfall, estimates for required capital upgrades and the associated costs were determined. The required upgrades have been categorized and prioritized to facilitate scheduling the requirements within budgetary and resource constraints. It is assumed that all major construction would be contracted out. The estimated costs are based upon KGS Group's experience with similar work, and discussions with local contractors, such as Nelson River Construction, Borland Construction and Uni-Jet Industrial Pipe Services having sewer rehabilitation and maintenance expertise.

The Water and Waste Department is currently addressing several concerns with identified problem outfalls. Additionally, several outfalls are currently being independently studied as part of the Combined Sewer Relief Projects or other infrastructure works such as the Provencher Bridge Replacement. The department has also identified one outfall as being redundant, and as such, this outfall was not considered for any repairs or maintenance. Table 7.1 lists the outfalls which are currently being addressed or otherwise are not considered for remedial work in this study even though they have been assessed an overall condition rating of 5.

7.1 Outfalls Requiring Structural Repairs

A total of 50 outfalls have been identified as requiring rehabilitation due to the structural failure of the pipe. Of these, 2 are discharge pipes from flood pumping stations (FPD or FPS), 6 are waste water sewer overflows (WWSO), 13 are combined sewer overflows (CS), and 29 are outfalls of the land drainage system (LDS).

Additionally 5 outfalls appear in the discussion below, and have an associated estimated cost assigned to them. The cost is, however, estimated based upon replacement of the existing pipe which may be subject to change depending upon the results of the Combined Sewer Relief Studies conducted and the scheduling of the Provencher Bridge Replacement Project.

Each outfall was assessed for the required repair work, and an estimated cost was assigned to each. Costs were also estimated to repair those outfalls rated 5, but smaller than 300 millimetres in diameter. Several of these outfalls were inspected and rated before the department directed KGS Group to concentrate on the larger pipes. For this reason the smaller pipes are included in the required structural repair estimate.

Table 7.2 lists the outfalls categorized as above, and prioritized according to risk of damage associated with total failure of the pipe. It is assumed that the FPDs are critical to minimize the chance of sewer backup during flood periods, and they are given the highest priority for repair. The next priorities were the overflow outfall pipes of the waste water and combined sewer systems respectively. The lowest priority was given to the repair of the land drainage sewer outfalls because the consequence of failure is not considered to be as significant. Priorities were also based on pipe size which was considered to be correlated to the amount of risk, assuming that larger pipes service larger areas and greater damage would result from their failure.

The table also shows the estimated costs to repair those outfalls rated 5, but smaller than 300 millimetres in diameter.

The costs shown in Table 7.2 are based upon current pricing of replacement materials from local suppliers, and installation included the excavation, bedding and backfill (1998 dollars). For purposes of this study it was assumed that the outfall pipes were to be replaced by new pipes of the same size and material. Further review of this assumption would be necessary at the design stage to optimize costs and design life of the rehabilitated outfalls. For the majority of the outfalls, the estimates include replacement of the entire length of pipe from the outlet to the first structure upstream. "Spot" or internal repairs for concentrated failure sections of pipe are noted where applicable.

Access to the site was also considered and costs were assessed based on the distance from the nearest river access point to the outfall. A premium was added for dewatering those outfalls that were submerged. This included an allowance for cofferdams, and pumping. The estimated repairs also took into consideration the restoration of the site, which was estimated to be $7.50 per square metre for new top soil and grass sod and $5.00 per square metre for new top soil and hydro-seeding. A detailed estimate of costs for the outfalls is included in Appendix G.

The total cost of $2,138,000.00 dollars for the rehabilitation of all the recommended outfalls is to be phased in over a 5 year period. The phasing of the repairs would coincide with other routine maintenance and inspection. A detailed discussion of the phasing of the repairs is provided in Section 9.2

7.2 Outfalls Requiring Bank Stability Repairs

Table 7.2 identifies a total of $565,000 in upgraded erosion protection estimated to be required as part of the reconstruction of outfalls with a structural rating of 5. The bank repairs are estimated to consist of riprap blankets or upgrading to existing riprap blankets. The intent is to significantly reduce lower toe erosion, the overall driving force behind most bank instability. Estimates were prepared on the basis of current market prices for riprap in place, which is approximately $30 per cubic metre.

Section 6.2 had identified a total 5 outfalls which were assigned a geotechnical rating of 5 (bank could fail at any time). Two of those four were dealt with under Table 7.2, and the other is RR-24 (Falconer) which has been scheduled for rehabilitation in 1998. The remaining two are SE-27 (Evans) and SE-39 (Morrow), both having a structural ratings of 1 or 2. On the one hand, the outfall pipes are in good structural condition (Pipe at SE-39 has recently been replaced). On the other hand, there is very direct evidence on site, that the bank may slump or fail at any time. Recommendations for rehabilitation alternatives for outfall replacements at locations where the riverbank is unstable are based upon an economic analysis. The following section presents this methodology for both SE-27 (Morrow) and SE-39 (Evans).

7.3 Economic Analysis of Rehabilitation Alternatives

A methodology for an economic analysis to compare rehabilitation alternatives of outfalls on unstable banks was developed by KGS Group, and reviewed by WWD, during the study (see the attached memorandum, date December 5, 1997, Appendix H). The memorandum presents two scenarios in which the justification for bank stabilization works, as opposed to rehabilitating the outfall pipes after a recurrence of a bank failure, is assessed. The first scenario considered that the consequence of bank failure is limited to the loss of the outfall, and there is no other significant economic impact such as flooding upstream due the pipe failure. The second scenario considered that additional loss would occur as a result of the bank failure. Additional losses beyond the direct damage to the outfall could include the loss of a flood pump station, and subsequent basement flooding upstream, and/or other important infrastructure works such as a street.

If there is no significant additional loss beyond the outfall pipe, the decision to proceed with bank stabilization works is made on the comparison of the present value of the cost of the bank stabilization works to the cost of the required pipe repairs during the expected life of stabilization measures.

When the risk of the loss of a flood pump station or other significant asset is considered, a benefit/cost ratio of annualized damages versus the costs of stabilization is assessed. Damages and costs are based upon the probability of bank failure combined with a significant rainstorm, and the associated damages (Loss of infrastructure and flood damages).

Both scenarios require the following data for the assessment:

- cost of the bank stabilization
- life expectancy of the bank stabilization works
- the frequency of which the bank is expected to fail, and
- the cost of the pipe rehabilitation works

As well, the second scenario also requires the following data:

- the consequences, in terms of damage to an FPS and potential district flooding if the FPS is out of service during a significant spring rainfall event where the pumps are required.

Both SE-27 (Morrow) and SE-39 (Evans) are part of the land drainage system, and the consequence of the bank failure is considered to be primarily limited to the loss of the outfall. The outfalls and adjacent bank conditions are considered to be similar, and the following economic factors were considered for the purpose of the evaluation:

- Bank stabilization costs range from $300,000 to $350,000
- Life expectancy of the bank stabilization works ranges from 30 to 50 years
- The frequency of which the bank is expected to fail ranges from 5 to 10 years
- The cost of the pipe rehabilitation works ranges from $40,000 to $60,000
- The discounted interest rate was assumed to be 5%

The above economic parameters were considered for the present value assessment and a sensitivity analysis for the range of parameters was conducted. Table 7.3(A) and Table 7.3(B) list the calculated present value of the pipe repair costs for an expected life span of 50 and 30 years respectively.

As can be seen by the tables, the present value of anticipated pipe repair costs ranges from $85,000 to $246,000 for all conditions. All values are less than the estimated initial expenditure of $300,000 to $350,000 for bank stabilization works. It can be concluded that, on this basis, the bank stabilization measures for SE-27 and SE-39 are not justifiable. That is, it would be more cost effective to make repairs to the outfall pipe at the anticipated frequency over the life expectancy of the stabilization works than it would be to perform the bank stabilization measures.

Outfall SE-27 (Evans) is located at the corner of Evans and Cusson Street, and the City has decided to barricade the street corner adjacent to the outfall because traffic loading could induce a slope failure. Homeowners in the vicinity must access their property via Cote or Deniset Street. Outfall SE-39 (Morrow) is situated between to two medium sized apartment buildings, and concerns of property damage associated with the unstable bank have been identified.

It is recommended that the City pursue the feasibility of cost sharing bank stability works with the adjacent stakeholders as was done for outfall, RR-24 (Falconer Bay). RR-24 failed because of its location on an unstable bank. The City is currently rehabilitating the outfall pipe, and the adjacent river bank as part of a negotiated cost sharing project. The adjacent residents have agreed to contribute funding to justify the total capital expenditure for the bank stabilization. If a similar arrangement can be negotiated with the adjacent stakeholders near SE-27 and SE-39 bank stability works should be re-evaluated. Negotiations could be based upon further economic analysis that would apportion property/infrastructure losses for both public and private stakeholders against the construction costs. Since each outfall location has specific requirements for rehabilitation, and the adjacent land ownership is also unique, each cost sharing project would have to be negotiated separately. No generic formula for apportioning the responsibility can be produced because of the number of factors involved in the negotiations.

TABLES

Table 7.1 Outfalls Not Considered for Remedial Work

Outfall Id No.	Outfall Name	Tributary	Size (mm)	Sewer Type	Comments
AS-12	Glasworthy Place	Assiniboine River	450	LDS	Scheduled for Rehabilitation in 1998
AS-14	Coleridge Park Drive South	Assiniboine River	450	LDS	Scheduled for Rehabilitation in 1998
RR-15	Rivergate Drive	Red River	1350	WWSO	Considered Redundant by WWD
RR-17	Minnetonka	Red River	2100	LDS	Scheduled for Rehabilitation in 1998
RR-24	Falconer Bay	Red River	1200	LDS	Scheduled for Rehabilitation in 1998

Table 7.2
Repair Cost Estimate for Outfalls with Structural Rating 5

Outfall ID#	NAME	Pipe size (mm)	Total Estimated Cost For Pipe Repairs	Total Estimated Cost For Erosion Protection	Total Estimated Cost	Comments
Pumping Stations and Flood Pumping Stations						
AS 74	Clifton Street FPD	2100	$ 62,000	$ 10,000	$ 72,000	Requires Rip Rap
RR 51	Marion Street FPD	1600	$ 47,000	$ 10,000	$ 57,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 55	Rue Despins FPD	1200	$ 37,000	$ 10,000	$ 47,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 60	Rue La Verendrye	600	$ 10,000	$ 25,000	$ 35,000	"Spot" repair 5 m; Pipe has shifted. Requires Rip Rap
	Subtotal		**$ 156,000**	**$ 55,000**	**$ 211,000**	
Waste Water Sewer Overflow						
RR 100	Whellams Lane	1200	$ 10,000	$ 10,000	$ 20,000	Requires Rip Rap
AS 23	Dieppe Road	650	$ 7,000	$ 5,000	$ 12,000	Incomplete inspection another cmp runs through pipe. Requires Rip Rap
RR 3	St. Norbert X-Kalay Lift Station Overflow	300	$ 15,000	$ 10,000	$ 25,000	Requires Rip Rap
AS 9.9	Sheir Dr.	250	$ 7,000		$ 7,000	
AS 26	Ridgedale S.P.S.	250	$ 11,000		$ 11,000	"Spot" repair 10 m; Side of CMP pushed in
AS 8	St. Charles Street 1	250	$ 8,000		$ 8,000	
	Subtotal		**$ 58,000**	**$ 25,000**	**$ 83,000**	
Combined Sewer Overflow						
RR 79	Hart Ave	2850	$ 78,000	$ 25,000	$ 103,000	Requires Rip Rap
AS 42	Conway CS	2500	$ 282,000	$ 50,000	$ 332,000	Requires Rip Rap
AS 61	Doncastor Street	2250	$ 145,000	$ 25,000	$ 170,000	Requires Rip Rap
AS 81	Ruby St. 1	2100	$ 51,000	$ 10,000	$ 61,000	Requires Rip Rap
AS 90	Colony Street	1800	$ 76,000	$ 25,000	$ 101,000	Requires Rip Rap
RR 52	Marion Street	1800	$ 60,000	$ 10,000	$ 70,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 90	Linden Ave.	1800	$ 30,000	$ 5,000	$ 35,000	Requires Rip Rap
RR 54	Rue Despins	1400	$ 41,000	$ 5,000	$ 46,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 58	Rue Doumoulin	1060	$ 29,000	$ 5,000	$ 34,000	Replacement cost only. Pricing is subject to replacement as part of the Future Provencher Bridge project. Requires Rip Rap
RR 96	Larchdale Cres. SPS	1050	$ 19,000	$ 10,000	$ 29,000	Requires Rip Rap
AS 37	Strathmillan Road	900	$ 23,000	$ 25,000	$ 48,000	Outfall is Submerged. Requires Rip Rap
AS 91	Kennedy Street	760	$ 36,000		$ 36,000	
AS 93	Hargrave Street	700	$ 24,000		$ 24,000	"Spot" repair 5 m; Pipe has shifted
AS 29	Woodhaven Blvd.	450	$ 38,000	$ 5,000	$ 43,000	Requires Rip Rap
RR 37	Calrossie Blvd	450	$ 14,000	$ 10,000	$ 24,000	Requires Rip Rap
AS 83	Arlington Street 1	375	$ 12,000		$ 12,000	Includes an extra 15m section to extend outfall into the river
	Subtotal		**$ 958,000**	**$ 210,000**	**$ 1,168,000**	

Land Drainage Sewer						
FL 2	Kildare at Floodway	3000	$ 257,000	$ 25,000	$ 282,000	Requires Rip Rap
ST 3	Booth Drive	1850	$ 28,000	$ 5,000	$ 33,000	Requires Rip Rap
AS 16.1	Raquette street 2	1800	$ 51,000	$ 5,000	$ 56,000	Requires Rip Rap
AS 19	Carroll Road	1800	$ 105,000	$ 30,000	$ 135,000	Requires Rip Rap
RR 7	Cloutier Drive (Segment 1 & 2)	1800/900	$ 48,000	$ 10,000	$ 58,000	"Spot" repair 5 m on Segment 1. Requires Rip Rap Repairs
RR 103	Valhalla Drive	1675	$ 50,000	$ 10,000	$ 60,000	Requires Rip Rap
FL 1	Deacon Reservoir	1500	$ 29,000		$ 29,000	Majority of the joints have started to separate, some > 25mm, Assume $15,000 to grout shifted joints
RR 31	Dunkirk Drive	1400	$ 23,000	$ 20,000	$ 43,000	Requires Rip Rap
AS 18	McCallum Cres.	1350	$ 12,000		$ 12,000	"Spot" repair 5 m; Outlet is damaged
RR 59	Rue La Verendrye	1200	$ 35,000	$ 25,000	$ 60,000	Requires Rip Rap
AS 10	Pender Street	900	$ 12,000		$ 12,000	"Spot" repair 5 m; Pipe outlet has some ice damage
RR 28	Dowker Ave. Outfall	900	$ 13,000	$ 10,000	$ 23,000	Requires Rip Rap
RR 68	Archibald Underpass	750	$ 23,000		$ 23,000	"Spot" repair 5 m; Pipe has shifted; Outfall is Submerged
AS 38	Vialoux Drive Cul-de-Sac	750	$ 28,000		$ 28,000	
OM 3	Empress Street 1	750	$ 24,000		$ 24,000	
RR 104	Red River Blvd.	750	$ 34,000		$ 34,000	
RR 30	Lotus lane	600	$ 10,000	$ 10,000	$ 20,000	Requires Rip Rap
SE 2	Rue Laverendrye	600	$ 9,000		$ 9,000	"Spot" repair 5 m; Pipe has shifted
RR 41	Churchill Drive Underpass	525	$ 14,000	$ 5,000	$ 19,000	Incomplete inspection too much sediment build-up. Requires Rip Rap
RR 108	Eastwood Drive	525	$ 28,000	$ 25,000	$ 53,000	Requires Rip Rap
AS 25	Shenfield Road	450	$ 28,000	$ 5,000	$ 33,000	Requires Rip Rap
AS 27	Ridgedale Cres	450	$ 12,000		$ 12,000	
BU 6	Delbrook Cres.	400	$ 11,000		$ 11,000	Pipe collapsed incomplete inspection.
RR 8	Stormont Drive	400	$ 9,000	$ 10,000	$ 19,000	Requires Rip Rap
ST 12	Amarynth Cres. 2	400	$ 13,000		$ 13,000	
ST 17	Harvest Lane	400	$ 17,000	$ 5,000	$ 22,000	Requires Rip Rap
OM 4	Veledrome 1	380	$ 8,000	$ 25,000	$ 33,000	Pipe collapsed incomplete inspection. Requires Rip Rap
RR 34	Oakcrest Place	375	$ 19,000	$ 50,000	$ 69,000	Requires Rip Rap
AS 70	Empress Street	300	$ 16,000		$ 16,000	
	Subtotal		**$ 966,000**	**$ 275,000**	**$ 1,241,000**	
	TOTAL		**$ 2,138,000**	**$ 565,000**	**$ 2,703,000**	

Table 7.3 (A) - Present Value of Pipe Repair Costs

Recurrence of Pipe Failure due to Bank Instability	PV Pipe Repair Costs for 50 Years		
	$40,000.00	**$50,000.00**	**$60,000.00**
5 years	$164,000.00	$205,000.00	$246,000.00
10 years	$93,000.00	$117,000.00	$140,000.00

Note: Assumes life expectancy of bank stability repairs is 50 years. PV rounded to nearest $1000

Table 7.3 (B) - Present Value of Pipe Repair Costs

Recurrence of Pipe Failure due to Bank Instability	PV Pipe Repair Costs for 30 Years		
	$40,000.00	**$50,000.00**	**$60,000.00**
5 years	$144,000.00	$180,000.00	$216,000.00
10 years	$85,000.00	$106,000.00	$127,000.00

Note: Assumes life expectancy of bank stability repairs is 30 years. PV rounded to nearest $1000

SECTION 8.0
Recommended
O & M

8.0 RECOMMENDED OPERATIONS AND MAINTENANCE

The following sections describe the required maintenance for those outfalls which have been impacted by bank erosion, sediment build-up within the outfall pipe and/or ice damage. Where possible maintenance is assumed to be performed by WWD personnel. Operational recommendations are also given for continued inspections of outfalls that are at risk of failure or require monitoring due to their present condition.

8.1 Outfalls Requiring Rip Rap Repairs

Inspections identified a total of 14 outfalls which were rated 5 in terms of erosion of the bank, and where neither the overall geotechnical rating nor the structural rating had yet dropped to category 5. Those outfalls are listed on Table 8.1 along with estimated costs to provide adequate erosion protection. The estimated total cost to upgrade the erosion protection is $97,500.

8.2 Outfalls Affected by Ice Damage

From the results of the outfall inspection program, 44 outfalls were identified as having been damaged by ice. Damages range from small dents in the pipes to damaged grates and severely damaged outlets. The outfalls were separated into major and minor damage categories, and are listed in Tables 8.2 and 8.3 respectively. The tables provide commentary on the extent of the damage and estimated costs of the associated repairs.

No formal priority was given to any of the particular outfalls requiring ice damage repairs. However, the 14 outfalls with major damage should be addressed prior to the remaining 24 categorized as having only minor damage. Approximately half of the outfalls with ice damage have also been assigned a failure condition rating of 5. Costs have not been assigned to repair these outfalls to eliminate duplication of expenditures. It is assumed that the capital upgrade work will include upgrading the outlet, and eliminate the need to fix any ice damage. Since the ice damage repairs and recommended capital upgrades are to be done within the same five year period, performing both tasks would effectively duplicate the cost for the repair. Phasing the repairs over time will be dependent on the rehabilitation schedule discussed in Section 9.0. It will also depend upon available WWD personnel and budget resources.

Total estimated costs associated with the repairs of the ice damage amount to $10,500.00 and $19,000.00 for the necessary major and minor repairs respectively. Each estimate was based on the repair work being performed by WWD personnel. It was assumed that three man crews, at $150.00 per crew hour, would be required to perform the repairs. The estimates took into account required materials and equipment, and a minimum for each repair was assessed at $1000.00. Details of the required repairs is presented in Appendix G.

8.3 Outfalls with Debris and Sediment Build-up

From those outfalls inspected, approximately 101 have restricted flow due to sediment or debris build-up inside the outfall pipe. For the purpose of prioritizing a list for recommended maintenance, the amount of the restriction has been placed into one of the two following categories:

- Major hydraulic restriction caused by sediment build-up of 50 percent or more of the pipe's total cross-sectional area.

- Minor hydraulic restriction caused by sediment build-up of less than 50 percent of the pipe's total cross-sectional area.

Table 8.4 lists 34 outfalls which are categorized as having major sediment build up, and Table 8.5 lists 67 outfalls categorized as having minor sediment build up. The table provides commentary on the amount of sediment build up in the pipe and an estimated cost associated with cleaning the pipe which is discussed below. As can be seen in the tables, four of the outfalls have been scheduled for service in 1998. It was requested that KGS Group forward to WWD a list of problem outfalls requiring maintenance. These outfalls were selected from the list forwarded to the WWD. upon request.

The outfalls on the list have been prioritized for maintenance purposes. The ranking is based upon several factors including:

- Amount of the sediment build up
- Risk of damage from sewer "backup" associated with the type of sewage conducted by the outfall
- Risk of damage from sewer "backup" associated with the drainage area of outfall which is correlated to the size of the outfall

The outfalls were ranked based on the amount of risk associated with creating a "backup" condition and the damages caused by the "backup". For example, a higher priority would be given to a large waste water sewer overflow with significant sediment build up, and a lower priority would be given to a smaller land drainage sewer with less sediment build up. Eight of the outfalls have been listed as severely obstructed. Three of the outfalls are currently being addressed by the department, but the remaining five should be serviced as soon as possible or determined to be redundant

The costs associated with cleaning the outfall pipes were estimated (see Table 8.4 and 8.5) based upon the following:

1. Estimated time to flush the pipe system based upon a working crew consisting of necessary flushing truck(s), vacuum truck, plus operators and labourer(s). Average cost of $300.00 per crew hour.
2. Estimated cost associated with difficult access to the site
3. Estimated cost associated with dewatering a submerged outfall

The total costs for flushing the outfalls affected by major sediment build up is estimated to be approximately $127,000.00, and the total costs associated with servicing the outfalls with minor sediment build up is estimated to be approximately $87,000.00. Those outfalls that are submerged below the water level will be particularly expensive to flush especially for the larger pipes. A premium cost has been estimated for each submerged outfall based on the requirement to dewater the pipe prior to flushing.

Although all outfalls have been assigned a cost, all are not necessarily required to be serviced immediately. The outfalls categorized as having major sediment build up should be serviced first, and staging of the remainder of the outfalls could follow according to the set priorities and/or budget resources. The phasing of the required maintenance should take into account other factors such as the outfalls overall condition rating. Should a particular outfall be restricted by sediment build up, and have an overall poor rating, a decision must be made to prioritize the maintenance or the rehabilitation of the manhole. This would eliminate duplication of resources. Further discussion on the overall phasing of the outfalls maintenance and rehabilitation is provided in Section 9.0.

8.4 Future Inspections

Continued inspection and assessment of the outfalls will ensure the performance of the outfalls over the long term. As well, It will provide the necessary information for effective maintenance programs. Future expenditures will depend upon accurately determining which outfalls require maintenance or upgrading as they deteriorate or reach their design life. An effective inspection program will take into consideration the current condition of an outfall, and when it was last inspected. The methodology for determining the requirements of future inspections, and a detailed 5 year plan is presented below. This method incorporates the developed information management system (IMS) as a tool to organize past and future inspections.

The IMS described in Section 5.0 should be used to assess which outfalls require inspection based upon their respective condition ratings and the date when they were last inspected. The following criteria is suggested for the timing of inspections based upon the condition rating:

1. Outfalls having an overall condition rating of 5 should be scheduled for repair or upgrade;
2. Outfalls with an overall condition rating of 4 should be reinspected within approximately 2 years of the date of the last inspection;
3. Outfalls with an overall condition rating of 3 should be reinspected within approximately 5 to 6 years of the date of the last inspection;

4. Outfalls with an overall condition rating of 1 or 2 should be reinspected within approximately 10 years of the date of last inspection.

The above criteria will allow for closer monitoring of those outfalls near a failure condition, but will also maintain a reasonable monitoring level on outfalls that are in good to fair condition. The criteria also provides a means for distributing the inspections over time, so that a more manageable number of inspections is performed each year. The criteria should be reviewed periodically, and time frames between inspection adjusted if necessary.

Based upon the suggested criteria and the recent inspection program, a 5 year plan for required inspections has been formulated as shown in Table 8.6. The plan also considers those outfall pipes which were unable to be inspected during this study, which include submerged outfall pipes and pipes equal to or smaller than 300 millimetres in size. The remaining inspections would be performed over two years to equally distribute the inspections over the next five years, and allow for extra time to perform inspections on submerged outfalls. A suggested listing of outfalls to inspect in the first two years is provided on Appendix I. As an estimate, the additional inspections are distributed equally among the rating classes, as it is probable that the resulting assessment could reveal any condition state for any given outfall. This is supported by the results of the outfalls assessed in this study.

The program has been established to be self sustaining. As certain outfalls will reach there design life and move to a higher priority rating (ie., their condition worsens) an equal number of outfalls will be repaired or upgraded to a satisfactory condition. Thus, a balance is achieved over time for the entire inventory of outfalls, and no additional inspections need be incorporated into the program, from year to year. The IMS tool, as developed, will aid managers in deciding which outfalls to inspect each year based upon the latest condition rating and the date of the last inspection. Using the specified criteria, a list of outfalls can be extracted from the database at the beginning of each inspection season.

It is assumed that the inspections will be performed using the methods developed during this study, and estimates of cost are provided. It is assumed that the costs will be similar for inspections performed by WWD personnel and by consultants because the same manpower and equipment are required. It is also assumed that the televised inspections would be performed by a local sewer services contractor.

The budget estimates presented in Table 8.6 do not include costs for outfalls not inspected in 1996-97 that will require special provisions for access. Provisions such as dewatering the pipe for submerged outfalls, sediment build-up removal or access to treated sewer outfalls from one of the three water pollution control centres. As listed in Table 4.2, 65 outfalls were not inspected because they were submerged, nine [9] outfalls were not inspected because there was no access to the outfall, and two [3] outfalls had severe sediment build-up problems that prevented inspection. For a listing of the outfalls which were not inspected, refer to Appendix E which describes each outfall and the reason it was not inspected.

The three outfalls with sediment build-up are scheduled for cleaning maintenance, and if successful the pipe can be inspected after the sediment is removed. Costs have been carried in the sediment build-up maintenance estimates for inspection.

No costs have been carried in the estimates for the three outfalls from the water pollution control centres. Because these outfalls are continuously discharging treated sewage to the river, the inspections would have to be coordinated with the individual centres, and may be performed at such time when the plants are down for major maintenance. The remaining six outfalls that KGS Group inspectors were locked or frozen out of should be accessible in the future without additional costs.

Future inspections for outfalls that were submerged during this study will depend on River levels and the practicality of dewatering the pipe. 40 of the 65 submerged outfalls were only partially submerged. Since the river levels were up to 2.5 feet higher than normal winter levels, it is assumed that most of the outfalls would be accessible during normal water level periods, at no additional cost. This may, however, affect the scheduling of some of the outfalls.

The final 25 outfalls that were not inspected in the 1996-97 survey were totally submerged. Ten of these outfalls were less than 1200 millimetres in diameter, and it is assumed that at normal winter water levels these outfalls would be at least partially accessible. It is recommended that an additional $2500.00 per outfall be estimated to dewater these outfalls. Typically these outfalls could be plugged at the outlet with a sewer safety/test plug, and then pumped dry. After dewatering, the outfalls could be inspected by CCTV unit. In order to justify the additional cost each outfall should be assessed independently on the basis of its current performance status and risk of failure due to the type of effluent it discharges. For this reason, no additional costs have been carried in the tables, but a contingency amount to a total $25,000.00 should be considered.

Nine of the 25 totally submerged outfalls were larger than 1200 millimetres in diameter. Although some may be partially accessible at this time, safety sewer plugs are not readily available for this pipe size. Inspections performed by divers would produce limited results, because of the opacity of the water/effluent. Costs associated with building a cofferdam in front of the outlet will vary greatly by location. A minimum 5 foot cofferdam is assumed, and will cost between $10,000.00 and $25,000.00 depending on the alternative best suited for the site. Alternative cofferdam systems include:

- Earth dam made from imported clay and fill at $10-12 per cubic metre in-place. These dams are the most common type in Winnipeg, but are labour intensive and costly.
- Sand bag dykes. Can be recovered from the river more readily, but are just as costly as earth dams.
- Rubber bladder ("Aqua dam") cofferdam, up to 9' high. These dams are portable, and cost effective, but have not been used locally.
- Modular sand dykes. These dykes are also transportable, but would require good site access for machinery. Costing data is not readily available, but is competitive with sand bag dykes, and is less manual labour intensive.

Not all alternatives will be practical for each site based upon the access to the outlet, and the bank profile and stability. From the above information, additional costs for inspecting these 9 outfalls could be as high as $150,000.00. Again, the additional cost for each outfall inspection should be assessed independently on the basis of its current performance status and risk of failure due to the type of effluent it discharges. For this reason, no additional dollar amounts have been carried in the estimate.

The last six outfalls that were totally submerged are submerged by design. They are part of the land drainage system, and drain into retention ponds that are part of the Bunn's Creek drainage area. The need for inspecting these pipes will be dependent on the risk of failure of these outfalls. An assessment of the pipes current performance would be indicative of the outfalls condition. Also, all six of these outfalls have been assessed with a geotechnical and stream rating of 1, which give no cause for concern associated with these aspects of the overall condition of the pipe. At this time, it is recommended that these pipes not be inspected structurally (internally) within the five year plan, but a geotechnical rating of the bank stability should be considered within five years. No additional cost has been carried for these outfalls.

TABLES

Table 8.1: Cost Estimate for Outfalls Requiring Erosion Protection Maintenance

Outfall ID	Name	Type	Size	Geotech CR	Struct CR	Cost Estimate [1] Erosion Protection
RR-19	Banning Rd.	LDS	1370	1	1	10,000.00
RR-2	Lemay Ave.	LDS	900	2	1	10,000.00
RR-21	Bishop Grandin Blvd. 2	LDS	750	1	2	10,000.00
RR-22	Plaza Dr.	LDS	2400	1	2	10,000.00
RR-82	Bredin Dr.	LDS	450	5	4	10,000.00
ST-22	Crestview Park Dr.	LDS	762	2	1	5,000.00
ST-3	Booth Dr.	LDS	1850	4	5	5,000.00
ST-4	Sturgeon Rd. (north)	LDS	1500	4		12,500.00
ST-7	Greenway Cres.	LDS	600	3	3	5,000.00
ST-7.1	Greenway Cres. 2	LDS	750	3		5,000.00
ST-8	Lonsdale Dr.	LDS	600	1	3	5,000.00
BU-1	Henderson Hwy.	LDS	1375	1	1	2,500.00
BU-13	Raleigh St. 1	LDS	400	3	3	2,500.00
BU-2	Henderson Hwy. 2	LDS	1200	4	1	5,000.00
Total						**97,500.00**

Note: [1] Based on \$500 per lineal meter of rip rap or \$25/m^3 and reasonable site access.

Table 8.2 Outfalls with Major Ice Damage at Outlet

Outfall ID No.	*Name*	*Size*	*Comments*	*Overall CR*	*Repair Cost*
AS-10	Pender St.	900	Outlet bent, opening reduced by 50 %.	5	$1,000.00
AS-13	Willow Ridge Rd.	1800	Outlet bent inwards and torn. Outfall extends from bank and could be trimmed back.	3	$1,000.00
AS-18	McCallum Cres.	1350	CMP bent closed at outlet. Opening reduced by 70%. Outfall extends from bank and could be trimmed back.	5	N/A[1]
AS-42	Conway CS	2500	Ice damage upstream side of outlet, top of CMP bent.	5	N/A[1]
AS-61	Doncaster St.	2250	CMP bent at outlet. Outfall extends from bank and could be trimmed back.	5	N/A[1]
AS-67	Wellington Cres. at CNR Bridge	450	Top of outlet is bent. Outfall extends from bank and could be trimmed back.	3	$1,000.00
AS-78	Elm St.	750	CMP bent at outlet, opening reduced by 25 %.	4	$1,000.00
AS-88	Cornish St. 2	1500	Grate is bent and twisted.	4	$4,000.00
RR-100	Whellams Lane	1200	Top of outfall flattened at end.	5	N/A[1]
RR-59	Rue La Verendrye	1200	Upstream side of outlet pushed in.	5	N/A[1]
RR-60	Rue La Verendrye FPS	600	Appears to be bent out of alignment in downstream direction.	5	N/A[1]
RR-79	Hart Ave.	2850x2130	Outlet bent and torn open.	5	N/A[1]
RR-87	Chelsea Pl	2275	First 1 m of pipe from outlet open and displaced from 3 to 9 o'clock due to ice damage.	4	$1,500.00
ST-16	Valleyview Dr. 2	1050	Top of outlet bent, grating damaged and hanging open.	4	$1,000.00
				TOTAL	**$10,500.00**

Notes: 1. Outfall is scheduled for capital upgrading which will account for costs of ice damage repairs.

Table 8.3 Outfalls with Minor Ice Damage at Outlet

Outfall ID No.	***Name***	***Size***	***Comments***	***Overall CR***	***Repair Cost***
AS-15	Paradise Bay	600	Outlet was slightly bent at top and side of pipe. Outfall extends from bank and could be trimmed back.	3	$1,000.00
AS-16.5	Orchard Park	600	Outlet is slightly bent. Outfall extends from bank and could be trimmed back.	3	$1,000.00
AS-19	Carroll Rd.	1800	Minor ice damage to outlet.	5	N/A[1]
AS-24	Fairmont	2500	Small piece of CMP was missing at outlet.	2	$6,000.00
AS-60	Chataway Blvd.	900	Outlet missing 250 mm piece between 3 and 5 o'clock.	4	$1,500.00
AS-63	Riverbend Cres.	2250	Upstream side of outlet bent.	4	$1,000.00
AS-67A	Route 90 Bridge	450	Top of pipe was bent. Opening reduced 10 - 20 %.	4	$1,000.00
AS-69	Tylehurst St.	2250	Ice damage to protective railing around outlet structure.	2	$1,000.00
AS-76	Ash St FPS	2100	Upstream portion of pipe is bent.	1	$1,000.00
BU-2	Henderson Hwy. 2	1200	Outlet slightly bent.	5	N/A[1]
BU-6.1	Delbrook Cres. 2	600	Top of outlet bent.	4	$1,000.00
FL-2	Kildare at Floodway	3000	Guard rail around outlet bent.	5	N/A[1]
LS-2	Rue Des Trappistes	450	Slight damage to top of pipe.	2	N/A[1]
OM-2	Clifton St. Overflow	2700	Chainlink fence on wingwall damaged.	2	$1,500.00
RR-10	Radcliffe 1	1200	Minor denting from 9:00 to 11:00	4	N/A[2]
RR-2	Lemay Ave.	900	Outlet dented from 6:00 to 2:00.	5	N/A[1]
RR-35	Wildwood Golf Course	900	Small dent at top of outlet.	3	N/A[2]
RR-38	Cockburn St. FPS	1500	Outlet slightly bent.	1	$1,000.00
RR-41	Churchill Dr. Underpass	800	Small dents at outlet from 9:00 to 12:00.	5	N/A[2]
RR-62	McDermot Ave.	2700	Tapered end of CMP slightly bent on upstream side.	4	$1,000.00
RR-90	Linden Ave.	1800	Concrete at outlet in poor condition.	5	N/A[1]
SE-37	Fermor Ave.	600	Outlet slightly bent.	4	$1,000.00
ST-1	Old Mill Rd.	400	40 mm dent at 9:00 upstream side.	3	N/A[2]
ST-22	Crestview Park Dr.	750	Small dents at 12:00 and 3:00.	5	N/A[2]
				TOTAL	**$19,000.00**

Notes: 1. Outfall is scheduled for capital upgrading which will account for costs of ice damage repairs.
2. Insignificant damage. Repair not necessary at this time. Monitor for increased damge in future.

Table 8.4 Major Sediment Build-up in Outfalls

Outfall Name	Outfall ID No.	Sewer Type	Size (mm)	Description of Sediment Build up	Condition Rating	Submerged	Difficult Access	Cost
Lombard Ave.	RR-61	CSO	900	100% of Pipe Area	3		✓	$12,000
Water Ave.	RR-56	CSO	457	100% of Pipe Area	3			$2,000
Rue Plinguet	SE-11	CSO	300	100% of Pipe Area	3			$1,200
Niakwa Rd. 2	SE-38.1	LDS	450	100% of Pipe Area	1			N/A[1]
Elmwood Park	RR-81	LDS	900	95% of Pipe Area	4		✓	$2,800
Lotus Lane	RR-30	LDS	600	95% of Pipe Area	5		✓	$2,800
Setter St.	ST-6	LDS	600	Severe sediment and debris build up from 2.1m to 31.5m.	2			$1,500
Wellington Cres.	AS-64	LDS	300	Severe.	4		✓	$2,200
Whellams Lane	RR-100	WWSO	1200	75% of Pipe Area	5			$2,400
Grandmont Blvd.	RR-6	WWSO	750	70% of Pipe Area	4			$1,800
Cote St.	SE-28	WWSO	450	75% of Pipe Area	4		✓	$2,200
Burrows Ave.	RR-76	CSO	2400	70% of Pipe Area	3			$4,000
Eccles St.	RR-47	CSO	750	80% of Pipe Area	3	✓		$7,800
Douglas Park Rd.	AS-57	CSO	300	75% of Pipe Area	2		✓	$2,200
Rossmere Cres.	RR-93	LDS	2900	70% of Pipe Area	3	✓		$13,500
St. Vital Bridge	RR-39.7	LDS	1600	80% of Pipe Area	2	✓	✓	$11,900
The Forks E. of CNR	AS-97	LDS	1200	75% of Pipe Area	2			$2,500
Eccles St. 2	RR-47.1	LDS	1200	70% of Pipe Area	2			$2,400
Vialoux Dr. Cul-de-Sac	AS-38	LDS	750	Major build up 13.5 m to 18 m. Minor build up 23 m to 33 m and 59.5 m to 64.2 m.	5		✓	$3,000
Rue St. Pierre	LS-1	LDS	300	75% of Pipe Area	4		✓	$3,000
Radcliffe	RR-11	WWSO	760	50% of Pipe Area	4		✓	$2,500
Alcott	ST-13	WWSO	600	50% of Pipe Area	3			N/A[1]
Crane Ave. Outfall	RR-27	CSO	900	50% of Pipe Area	4			$1,800
Fermor Ave	RR-32.5	LDS	1950	50% of Pipe Area	3	✓	✓	$13,400
Summerview Lane	RR-106	LDS	1800	50% of Pipe Area	3	✓	✓	$11,900
Churchill High School	RR-47.5	LDS	1600	50% of Pipe Area	2	✓		$9,300
Raleigh St. 3	BU-15	LDS	750	50% of Pipe Area	3			$1,500
Bonner Ave.	BU-3	LDS	525	50% of Pipe Area	2			$1,200
Rue Bourgeault	SE-10	LDS	450	50% of Pipe Area	4			$1,200
Amarynth Cres. 2	ST-12	LDS	400	50% of Pipe Area	5			N/A[2]
Ridgedale S.P.S.	AS-26	WWSO	250	Infilled at outlet.	5			N/A[2]
Chataway Blvd.	AS-60	CSO	900	Infilled from 8 to 11.5 m and 14.6 to 16.9 m.	4			$1,800
Hargrave St.	AS-93	CSO	700	Infilled causing water backup at 10.6 m.	5			N/A[2]
Empress Street 2	AS-71	LDS	300	Infilled at 58.6 m.	3			$1,200
							Total	$127,000

Notes: 1. Outfall scheduled to be cleaned in 1998
2. Outfall is scheduled for capital upgrading which will account for costs associated with sediment buildup

Table 8.5 Minor Sediment Build-up in Outfalls

Outfall Name	Outfall ID No.	Sewer Type	Size (mm)	Description of Sediment Build up	Condition Rating	Submerged	Difficult Acess	Cost
Valleyview Dr. 1	ST-15	WWSO	600	35% of Pipe Area	4			$1,800
Selkirk Ave.	RR-74	CSO	1800	35% of Pipe Area	3			$1,200
Killarney St.	RR-43	LDS	1200	40% of Pipe Area	2			$1,200
Larchdale Cres. SPS	RR-96	LDS	1050	40% of Pipe Area	5			N/A[2]
Churchill Dr. Underpass	RR-41	LDS	800	35% of Pipe Area	5			N/A[2]
Silver Ave.	ST-19	WWSO	525	Moderate sediment build up from 0m to 5m and from 73m to 80m.	4			$1,200
McDermot Ave.	RR-62	CSO	2700	25% of Pipe Area	4			$2,000
Riverbend Cres.	AS-63	CSO	2300	Sediment is considerable towards end of pipe.	4			$1,800
Colony St.	AS-90	CSO	1800	25% of Pipe Area	5			N/A[2]
Wildwood Golf Coarse	RR-35	CSO	900	Moderate throughout enitre length.	3			$1,500
Crane Ave.	RR-26	CSO	600	Moderate sediment build up in pipe from 55 m to 89 m.	4			$1,200
Pritchard Ave.	RR-75	CSO	250	25% of Pipe Area	4			$1,200
Chelsea Pl	RR-87	LDS	2260	Measurement L3 to water in pipe. Moderate	4			$1,800
John Black Ave.	RR-101	LDS	1800	30% of Pipe Area	2			$1,800
Valleyview Dr. 2	ST-16	LDS	1050	Some moderate sediment build up in concrete portion of pipe and at pipe outlet.	4			$1,200
La Maire Ave.	LS-4	LDS	1000	25% of Pipe Area	2			$1,200
Bishop Grandin Blvd. 2	RR-21	LDS	750	Moderate build up from 54 m to outlet.	5			N/A[2]
Victoria Cres. 2	RR-29	LDS	750	30% of Pipe Area	4	✓	✓	$6,800
Kingston Row Underpass	RR-40	LDS	750	30% of Pipe Area	4			$1,200
Riverdale Ave.	RR-34.8	LDS	600	25% of Pipe Area	3			$1,200
Delbrook Cres.	BU-6	LDS	400	25% of Pipe Area	5			N/A[2]
Metcalfe Pl.	RR-46	CSO	2000	15% of Pipe Area	4			$1,800
Newton Ave.	RR-94	CSO	1850	20% of Pipe Area	2			$1,800
Baltimore St. FPS	RR-45	CSO	1800	20% of Pipe Area	4			$1,800
Linden Ave.	RR-90	CSO	1800	Up to 300 mm of sediment build up.	5			N/A[2]
Arbuthnot	AS-87	CSO	1400	15% of Pipe Area	3			$1,500
Park Bvld.	AS-58	LDS	2400	Some sediment at 13m from outlet.	3			$1,800
Renfrew St.	AS-72	LDS	2400	20% of Pipe Area	2	✓		$10,500
Dunham Rd. Outfall	RR-33	LDS	1200	20% of Pipe Area	3	✓		$6,500
St. Charles St. 2	AS-9	LDS	900	Some debris in line from 27.2 m to 41.9 m and 49.3 m to 53.7 m.	3			$1,200
Dowker Ave. Outfall	RR-28	LDS	900	15% of Pipe Area	5			N/A[2]
Guay Ave.	SE-30	LDS	750	Some debris in pipe and debris build up on	4			$1,200
Fermor Ave.	SE-37	LDS	600	Some debris build up in pipe.	4			$1,200
							Subtotal	**$57,600**

Notes: 1. Outfall scheduled to be cleaned in 1998
2. Outfall is scheduled for capital upgrading which will account for costs associated with sediment buildup

Table 8.5 Minor Sediment Build-up in Outfalls (continued)

Outfall Name	*Outfall ID No.*	*Sewer Type*	*Size (mm)*	*Description of Sediment Build up*	*Condition Rating*	*Submerged*	*Difficult Acess*	*Cost*
Lonsdale Dr.	ST-8	LDS	600	Some sediment build up in concrete pipe.	5			N/A[2]
Bredin Dr.	RR-82	LDS	450	20% of Pipe Area	5			N/A[2]
Harvest Lane	ST-17	LDS	400	Some sediment build up from 16.6m to 18m.	5			N/A[2]
Hart Ave.	RR-79	CSO	2850	Minor sediment build up in pipe	5			N/A[2]
Clifton St. FPD	AS-74	CSO	2100	Sediment build up at outlet.	5			N/A[2]
Donald St.	AS-94	CSO	1900	10% of Pipe Area	3			$1,800
Rue Despins	RR-54	CSO	1400	10% of Pipe Area	5			N/A[2]
Rue La Verendrye	RR-59	CSO	1200	Minor sediment build up in pipe.	5			N/A[2]
Strathmillan Rd.	AS-37	CSO	900	Minor vegetation and sedimentation	5	✓		N/A[2]
Maryland St.	AS-86B	CSO	600	Minor sediment build up in pipe	3	✓		$5,200
Rue La Verendrye FPS	RR-60	CSO	600	Minor sediment from 3 m to 6.5 m. Moderate debris in pipe from 20.5 m to 34 m.	5			N/A[2]
Booth Dr.	ST-3	LDS	1850	Minor sediment build up in pipe	5			N/A[2]
Crestview Park Dr.	ST-21	LDS	1676	Minor sediment built up	4			$1,500
Hamilton Ave.	ST-18	LDS	1500	Minor sediment build up in pipe	4			$1,500
Radcliffe 1	RR-10	LDS	1200	10% of Pipe Area	4			$1,500
Southbridge Dr.	SE-43	LDS	900	Some minor sediment build up in conc. portion of pipe.	1		✓	$2,200
Archibald Underpass	RR-68	LDS	750	Debris in pipe at 4.6 m	5	✓		N/A[2]
Niakwa Rd. 1	SE-38	LDS	450	Minor sediment and debris build up in pipe.	1			$1,200
Ash St FPS	AS-76	CSO	2100	> 5% of Pipe Area	1			$1,800
Rue Dumoulin 3	RR-58	CSO	1060	> 5% of Pipe Area	5			N/A[2]
Plaza Dr.	RR-22	LDS	2400	> 5% of Pipe Area	5			N/A[2]
Glasgow Ave.	RR-48	LDS	1200	5% of Pipe Area	4			$1,500
Ruby St. 1	AS-81	CSO	2100	Sediment build up from outlet to 10 m in pipe.	5			N/A[2]
Polson Ave. FPS	RR-83	CSO	1800	Measurement L3 affected by ice in pipe.	3			N/A[1]
Linden Ave. - Flood	RR-91	CSO	1675	Sediment and debris build up in pipe.	3			$1,500
Kennedy St.	AS-91	CSO	760	From 85m to 92 m.	5			N/A[2]
Park Dr.	RR-50.5	LDS	1200	Sediment and debris build up throughout length of pipe.	3			N/A[1]
River Pointe Pl.	RR-18	LDS	1050	Stone in end of outfall	4			$1,200
Lanoo Dr.	AS-21.5	LDS	900	Sediment and debris from 7.4 m to 31.1 m.	3	✓	✓	$7,500
Wellington Cres. 2	AS-66.8	LDS	450	Debris in pipe 1.5 m to 3.8 m.	2			$1,200
Empress Street	AS-70	LDS	300	Sediment build up at outlet.	5			N/A[2]

Subtotal **$29,600**

Total (rounded to nearest $1000) **$87,000**

Notes: 1. Outfall scheduled to be cleaned in 1998
2. Outfall is scheduled for capital upgrading which will account for costs associated with sediment buildup

Table 8.6
Five Year Plan for Future Inspections

Description	Number of Inspections Required		Estimated Cost
	Televised	"Walk-Through"	
Year 1 (1999)			
Overall Condition Rating of 4 from 96-97	31	21	$28,000
Not Inspected 96-97(approx. ½)[1]	17	21	$23,000
Outfall not inspected < 300 mm dia. (approx. ½)	28	0	$10,000
Subtotal	76	42	$61,000
Year 2 (2000)			
Not Inspected 96-97(approx. ½)[1]	17	22	$24,000
Outfall not inspected < 300 mm dia. (approx. ½)	28	0	$10,000
Subtotal	45	22	$34,000
Year 3 (2001)			
Overall Condition Rating of 4, Last inspection dated earlier than Year 1[2]	40	25	$30,000
Subtotal	40	25	$30,000
Year 4 (2002)			
Overall Condition Rating of 4, Last inspection dated earlier than Year 2[2]	9	4	$7,000
Subtotal	9	4	$7,000
Year 5 (2003)			
Overall Condition Rating of 3 from 96-97	16	17	$19,000
Overall Condition Rating of 4, Last inspection dated earlier than Year 3[2]	35	22	$30,000
Subtotal	51	39	$49,000
***Total*[3]**			**$181,000**

Notes:
1. Estimate does not include costs to dewater those outfalls which are submerged
2. Estimate only based upon previous number of outfalls with an overall rating of 4 or 3, and a 20% chance that outfalls not inspected would be rated 4 or 3
3. Rounded to the nearest $1000

SECTION 9.0
Phasing of Capital
and O & M

9.0 PHASING OF CAPITAL UPGRADES AND MAINTENANCE

The Water and Waste Department (WWD) requested that the recommended capital upgrades and maintenance costs be distributed over a 5 year period for budgeting purposes. The following sections describe the recommended phased approach to the capital and maintenance expenditures. The recommendations are based upon the assigned priority for upgrades and maintenance categories.

9.1 Capital Upgrades 5 Year Plan

Based upon the estimated costs and priority ranking assigned to those outfalls that require capital upgrade repairs (see Sections 7.1 and 7.2), a phased approach for completing the work is recommended. The WWD has budgeted approximately $552,000.00 per year for the next 5 years for capital upgrades. Table 9.1 lists outfalls to be upgraded for each year, and their estimated total cost of repair. The costs shown include allowances for engineering, WWD overhead and contingencies. The cost estimates are, however, shown in constant 1998 dollars, and do not account for inflation. A current rates of inflation the contingencies carried in the estimate should be sufficient to cover extra costs due to anticipated inflation.

As can be seen in Table 9.1, the list closely follows the rankings discussed for priority of repair. To stay within budgetary constraints minor changes to the ranking order were necessary.

Due to the total amount of the estimated capital upgrade costs, it will be difficult to repair any additional outfalls than those specified in the 5 year plan. The existing $552,000.00 per year budget does not allow for the incorporation of more outfall repairs that may be required as additional outfall pipes reach a failed state.

9.2 Operations and Maintenance 5 Year Plan

As discussed in Chapter 8, the suggested operations and maintenance (O&M) program consists of rip rap repairs, ice damage repairs, sediment build-up maintenance and a continued inspection program. Table 9.2 summarizes the recommended O&M 5 year plan. The estimated expenditures are distributed relatively equal over the period. Initially, higher costs will be incurred for major maintenance items that require attention over the short term. All estimates shown are presented in constant 1998 dollars.

The percentages shown for the Item description represent the portion of the overall required maintenance for the category. The maintenance should be performed in the priority order set for each category, as discussed in Chapter 8. Additional allowances have been made for ice damage repairs and sediment build-up maintenance as part of an overall O&M program. It is recommended that the WWD carry approximately $100,000.00 per year in the O&M budget to accommodate routine maintenance and inspection operations.

Figure 1, illustrates the total recommended budget plan for the next 5 years. It includes a bar chart for both required capital upgrades and O&M expenditures.

TABLES

Table 9.1
Recommended 5 Year Outfall Capital Upgrades Plan

Outfall ID#	NAME	Stream	Pipe size (mm)	Total Estimated Cost For Pipe Repairs	Total Estimated Cost For Erosion Protection	Total Estimated Cost	Year of Repair
AS 74	Clifton Street FPD	Assiniboine	2100	$ 62,000	$ 10,000	$ 72,000	1
RR 60	Rue La Verendrye	Red	600	$ 10,000	$ 25,000	$ 35,000	1
RR 100	Whellams Lane	Red	1200	$ 10,000	$ 10,000	$ 20,000	1
AS 23	Dieppe Road	Assiniboine	650	$ 7,000	$ 5,000	$ 12,000	1
RR 3	St. Norbert X-Kalay Lift Station Overflow	Red	300	$ 15,000	$ 10,000	$ 25,000	1
AS 9.9	Sheir Dr.	Assiniboine	250	$ 7,000		$ 7,000	1
AS 26	Ridgedale S.P.S.	Assiniboine	250	$ 11,000		$ 11,000	1
RR 79	Hart Ave	Red	2850	$ 78,000	$ 25,000	$ 103,000	1
AS 61	Doncastor Street	Assiniboine	2250	$ 145,000	$ 25,000	$ 170,000	1
AS 81	Ruby St. #1	Assiniboine	2100	$ 51,000	$ 10,000	$ 61,000	1
RR 90	Linden Ave.	Red	1800	$ 30,000	$ 5,000	$ 35,000	1
	Subtotal			**$ 426,000**	**$ 125,000**	**$ 551,000**	
RR 51	Marion Street FPD[1]	Red	1600	$ 47,000	$ 10,000	$ 57,000	2
AS 42	Conway CS	Assiniboine	2500	$ 282,000	$ 50,000	$ 332,000	2
RR 52	Marion Street[1]	Red	1800	$ 60,000	$ 10,000	$ 70,000	2
AS 90	Colony Street	Assiniboine	1800	$ 76,000	$ 25,000	$ 101,000	2
	Subtotal			**$ 465,000**	**$ 95,000**	**$ 560,000**	
AS 8	St. Charles Street #1	Assiniboine	250	$ 8,000		$ 8,000	3
RR 55	Rue Despins FPD[1]	Red	1200	$ 37,000	$ 10,000	$ 47,000	3
RR 96	Larchdale Cres. SPS	Red	1050	$ 19,000	$ 10,000	$ 29,000	3
AS 37	Strathmillan Road	Assiniboine	900	$ 23,000	$ 25,000	$ 48,000	3
AS 91	Kennedy Street	Assiniboine	760	$ 36,000		$ 36,000	3
AS 93	Hargrave Street	Assiniboine	700	$ 24,000		$ 24,000	3
AS 29	Woodhaven Blvd.	Assiniboine	450	$ 38,000	$ 5,000	$ 43,000	3
RR 37	Calrossie Blvd	Red	450	$ 14,000	$ 10,000	$ 24,000	3
AS 83	Arlington Street 1	Assiniboine	375	$ 12,000		$ 12,000	3
ST 3	Booth Drive	Sturgeon	1850	$ 28,000	$ 5,000	$ 33,000	3
AS 16.1	Raquette street 2	Assiniboine	1800	$ 51,000	$ 5,000	$ 56,000	3
AS 19	Carroll Road	Assiniboine	1800	$ 105,000	$ 30,000	$ 135,000	3
FL 1	Deacon Reservoir	Floodway	1500	$ 29,000		$ 29,000	3
AS 18	McCallum Cres.	Assiniboine	1350	$ 12,000		$ 12,000	3
AS 10	Pender Street	Assiniboine	900	$ 12,000		$ 12,000	3
	Subtotal			**$ 448,000**	**$ 100,000**	**$ 548,000**	
RR 54	Rue Despins[1]	Red	1400	$ 41,000	$ 5,000	$ 46,000	4
FL 2	Kildare at Floodway	Floodway	3000	$ 257,000	$ 25,000	$ 282,000	4
RR 7	Cloutier Drive (Segment 1 & 2)	Red	1800/900	$ 48,000	$ 10,000	$ 58,000	4
RR 103	Valhalla Drive	Red	1675	$ 50,000	$ 10,000	$ 60,000	4
RR 31	Dunkirk Drive	Red	1400	$ 23,000	$ 20,000	$ 43,000	4
RR 28	Dowker Ave. Outfall	Red	900	$ 13,000	$ 10,000	$ 23,000	4
RR 68	Archibald Underpass	Red	750	$ 23,000		$ 23,000	4
	Subtotal			**$ 455,000**	**$ 80,000**	**$ 535,000**	
RR 58	Rue Doumoulin[1]	Red	1060	$ 29,000	$ 5,000	$ 34,000	5
RR 59	Rue La Verendrye	Red	1200	$ 35,000	$ 25,000	$ 60,000	5
AS 38	Vialoux Drive Cul-de-Sac	Assiniboine	750	$ 28,000		$ 28,000	5
OM 3	Empress Street 1	Omands	750	$ 24,000		$ 24,000	5
RR 104	Red River Blvd.	Red	750	$ 34,000		$ 34,000	5
RR 30	Lotus lane	Red	600	$ 10,000	$ 10,000	$ 20,000	5
SE 2	Rue Laverendrye	Seine	600	$ 9,000		$ 9,000	5
RR 41	Churchill Drive Underpass	Red	525	$ 14,000	$ 5,000	$ 19,000	5
RR 108	Eastwood Drive	Red	525	$ 28,000	$ 25,000	$ 53,000	5
AS 25	Shenfield Road	Assiniboine	450	$ 28,000	$ 5,000	$ 33,000	5
AS 27	Ridgedale Cres	Assiniboine	450	$ 12,000		$ 12,000	5
BU 6	Delbrook Cres.	Bunn's	400	$ 11,000		$ 11,000	5
RR 8	Stormont Drive	Red	400	$ 9,000	$ 10,000	$ 19,000	5
ST 12	Amarynth Cres. 2	Sturgeon	400	$ 13,000		$ 13,000	5
ST 17	Harvest Lane	Sturgeon	400	$ 17,000	$ 5,000	$ 22,000	5
OM 4	Veledrome 1	Omands	380	$ 8,000	$ 25,000	$ 33,000	5
RR 34	Oakcrest Place	Red	375	$ 19,000	$ 50,000	$ 69,000	5
AS 70	Empress Street	Assiniboine	300	$ 16,000		$ 16,000	5
	Subtotal			**$ 344,000**	**$ 165,000**	**$ 509,000**	
	TOTAL			**$ 2,138,000**	**$ 565,000**	**$ 2,703,000**	

Note: 1. Prices Subject to results of Combined Sewer Relief Study or Provencher Bridge Replacement

Table 9.2
Recommended Operations and Maintenance 5 Year Plan

Item Description	Estimated Cost
Year 1	
Rip Rap Maintenance[1]	$19,500
Major Ice Damage Repairs	$10,500
Major Sediment Build-up Maintenance[2]	$63,500
Outfall Inspections	$61,000
Subtotal	**$154,500**
Year 2	
Rip Rap Maintenance[1]	$19,500
Minor Ice Damage Repairs	$19,000
Major Sediment Build-up Maintenance[2]	$63,500
Outfall Inspections	$34,000
Subtotal	**$136,000**
Year 3	
Rip Rap Maintenance[1]	$19,500
Ice Damage Repairs (allowance)	$5,000
Minor Sediment Build-up Maintenance[3]	$43,500
Outfall Inspections	$30,000
Subtotal	**$98,000**
Year 4	
Rip Rap Maintenance[1]	$19,500
Ice Damage Repairs (allowance)	$5,000
Minor Sediment Build-up Maintenance[3]	$43,500
Outfall Inspections	$7,000
Subtotal	**$75,000**
Year 5	
Rip Rap Maintenance[1]	$19,500
Ice Damage Repairs (allowance)	$5,000
Sediment Build-up Maintenance (allowance)	$25,000
Outfall Inspections	$49,000
Subtotal	**$98,500**
Total	***$562,000***

Notes: 1. Amount shown is 20% of total estimated costs for rip rap repairs
2. Amount shown is 50% of estimated major sediment build-up maintenance
3. Amount shown is 50% of estimated minor sediment build-up maintenance

FIGURES

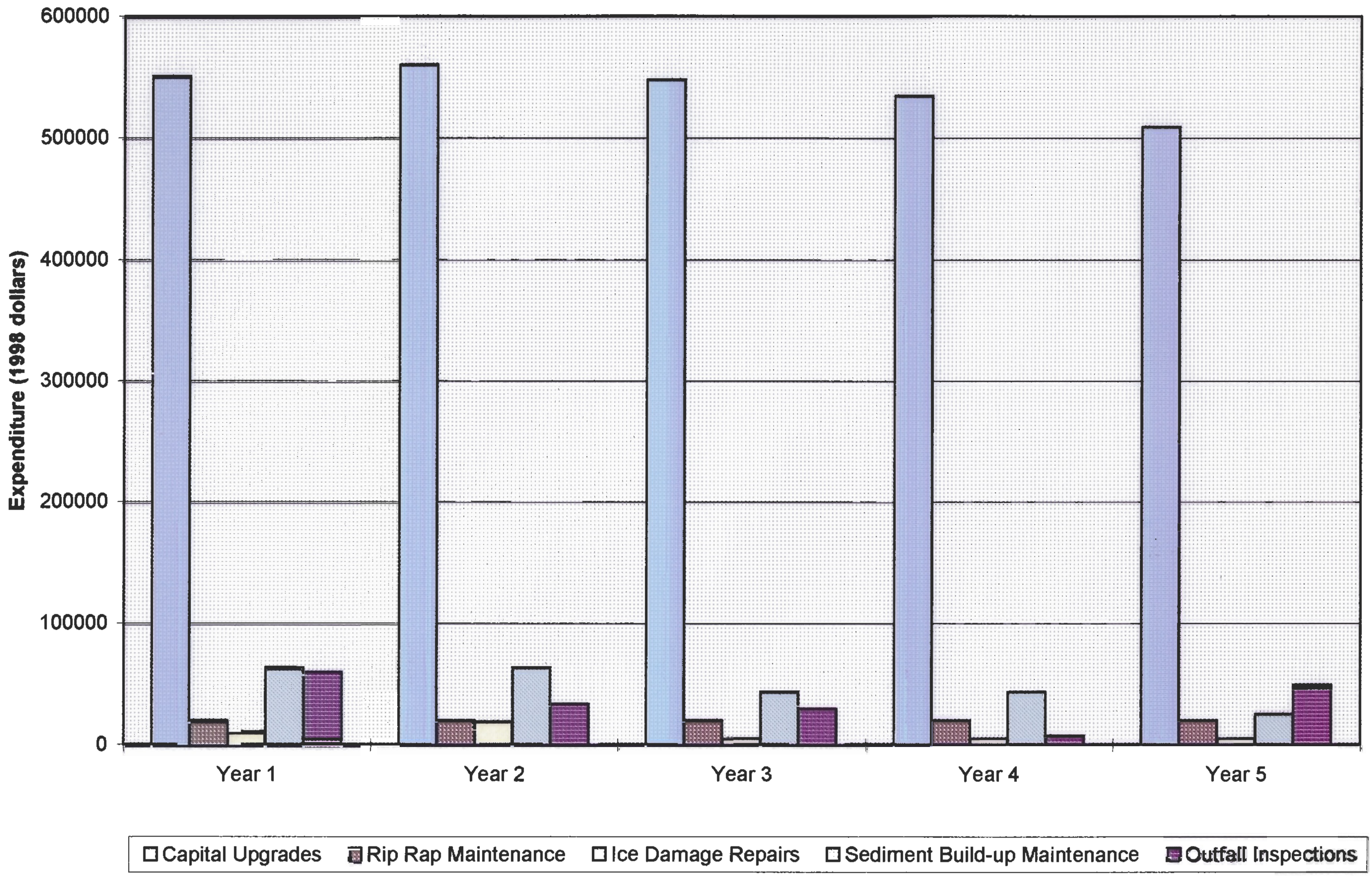


Figure 1
Recommended Outfall Budget
5 Year Plan

SECTION 10.0
Conclusions

10.0 CONCLUSIONS

Based upon the results of the study, the following conclusions are presented.

10.1 Inventory Review

1. An inventory review found 387 outfalls exist and are active on the rivers and streams within the City of Winnipeg boundary. The Water and Waste Department has jurisdiction over 349 outfalls, and 37 are under the responsibility of other civic departments, or the private sector.

2. The updated inventory listing did not include 12 outfalls identified in previous studies because they were not located or have since been abandoned.

3. During the inventory review it was noted that the City's Land Based Information System (LBIS) was missing or incorrectly identified several outfalls. KGS Group had proposed updating the LBIS database, which was subsequently authorized by the Steering Committee. A detailed list of discrepancies was forwarded separately from this report.

10.2 Inspection Program

1. An inspection methodology and rating system were developed for the condition assessment of the outfalls. The overall condition assessment was based upon the structural, geotechnical and stream condition at the location. A 5 point rating system was developed based upon a rating of 1 representing a fully satisfactory condition, and 5 represents a failed condition.

2. The inspections were phased over two "low water" seasons due to above normal river levels, and record snow accumulations.

3. KGS Group was directed to inspect only those outfalls which were under the jurisdiction of the Water and Waste Department, and further direction was given to focus on outfalls that were greater than 300 millimetres in diameter.

4. Of the 259 outfalls that were to be inspected, 71 percent were completed. The remaining outfalls were unable to be inspected due to submergence or a lack of access. Submergence of the outfalls was due primarily to high river levels.

10.3 Information Management System

1. All inventory and inspection information was entered into an Information Management System (IMS). The database was developed with a full featured user interface that allowed for Data Entry, Data Update, Database Searching and Database Reporting.

2. All 387 outfalls identified during the inventory review process were entered into the database regardless of their individual inspection status. Information on outfalls not inspected to date can be updated on the IMS once inspections have been completed.

10.4 Condition Assessment

1. The condition assessment program concluded that a total of 71 outfalls have reached a failed state. Categorically, 47 outfalls have failed structurally, 2 outfalls have failed due to unstable river banks, and 13 outfalls have failed due to stream erosion (hydraulics) problems. The remaining 8 outfalls have reached a failed condition in two or more of the rating categories.

2. It was determined that approximately 66 percent of the failed outfalls were part of the land drainage system.

10.5 Capital and Maintenance Upgrades

1. Of the recommended capital upgrades the majority of the rehabilitation require that the outfall be replaced throughout its entire length. A smaller number, 8, of the outfalls require only "spot" repairs at specific sections of the outfall where the failure is localized. In addition, one outfall was noted as having significant joint displacement, and this outfall could be repair internally by grouting the displaced joints over the length of the pipe.

2. The O&M costs for future inspections do not account for costs associated with dewatering outfall pipes prior to the inspection. It is anticipated that at normal winter water levels most outfalls will be accessible, at little or no additional cost. Where substantial costs can be incurred for cofferdams, it is recommended that each outfall be assessed for its overall performance, consequence of failure, and cost for access before proceeding with planning an internal inspection. Bank stability and stream conditions should be monitored accordingly.

3. The IMS tool developed can will managers in deciding which outfalls to inspect each year based upon the latest condition rating and the date of the last inspection. Guidelines for scheduling inspections have been developed on this basis.

10.6 Recommended 5 Year Plan

.1 A yearly budget of $552,000.00 over the next five years has been assigned by the WWD for capital upgrade costs to sewer outfalls. Based upon the results of the Outfall Condition and Maintenance Study this amount appears to be adequate at this time.

SECTION 11.0
Recommendations

11.0 RECOMMENDATIONS

Based upon the results of the study, the following recommendations are presented.

11.1 Information Management System

1. As directed by the WWD, the developed IMS does not have any programmed security functions. It was deemed unnecessary at this time, and the Water and Waste Department could program the security features at a later date. KGS Group recommended that this course of action take place because the WWD custodian of the database can customize the system according to the needs of the department.

11.2 Condition Assessment

1. KGS group inspected and assessed 9 outfalls which were smaller than 300 millimetres in diameter. Of these, 6 were deemed to be in a failed state. Such a high percentage warrants an inspection program for these outfalls.

11.3 Capital and Maintenance Upgrades

1. It was recommended that the WWD include a contingency amount of $25,000.00 in the future inspections budget to account for dewatering of totally submerged outfalls which can be inspected with a CCTV camera.

2. Total recommended capital upgrade costs are estimated to be $2,703,000.00, which includes an estimated $2,138,000.00 for required outfall pipe rehabilitation, and $565,000.00 for required erosion protection upgrades, which consist primarily of rip rap rehabilitation. The total estimate includes engineering fees, contingencies and an overhead allowance.

3. Operations and maintenance (O&M) costs are estimated to be $522,000.00. This amount includes estimates for the required rip rap ($97,500.00) and ice damage ($29,500.00) repairs, sediment build-up maintenance ($214,000.00), and the recommended continued inspection program ($181,000.00), which includes outfalls not inspected during this study.

4. A methodology was developed for evaluating outfall rehabilitation alternatives on unstable banks. Outfall SE-27 (Evans) and SE-39 (Morrow) are two outfalls that were found to be located on unstable banks. It was concluded that it would be more cost effective to make repairs to the outfall pipe at the anticipated frequency over the life expectancy of the

stabilization works than it would be to perform the bank stabilization measures at these two locations. It is recommended, however, that the Water and Waste Department pursue a cost shared arrangement with both public and private stakeholders at each location to re-evaluate the bank stabilization work. A cost sharing scheme would have to be devised separately for each location based upon many factors such as adjacent land use and ownership.

11.4 Recommended 5 Year Plan

1. A 5 year plan for the recommended capital upgrades is based upon an annual budget of \$552,000.00. Yearly recommended upgrades were based upon criteria developed for the consequence of a complete pipe failure. It is recommended that the flood pump station outfalls be rehabilitated first. Followed by waste water sewer overflows, combined sewer overflows, and land drainage sewers respectively. Drainage areas and pipe size were also used as ranking criteria.

2. A 5 year plan for O&M was established. Estimated O&M costs resulting from this study were evenly spread out over the next five years, and it is recommended that the water and waste department maintain a funding level of \$100,000.00 per year for future maintenance requirements.

APPENDIX A
River & Stream
Outfall Drawings

APPENDIX A

RIVER AND STREAM OUTFALL INVENTORY DRAWINGS

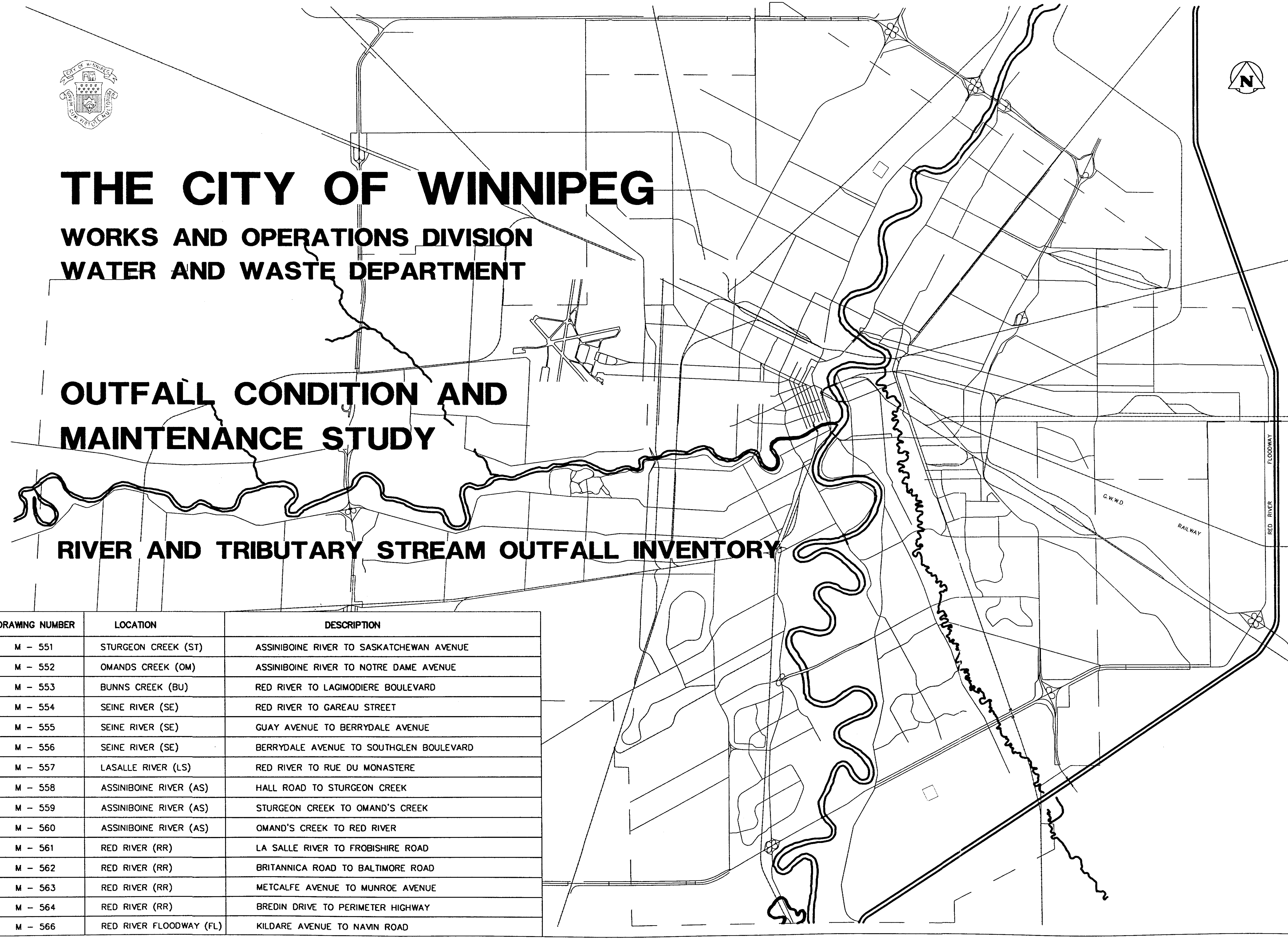
PROPERTY
OF THE
WATER & WASTE DEPARTMENT
RESOURCE CENTRE
1500 PLESSIS ROAD

THE CITY OF WINNIPEG

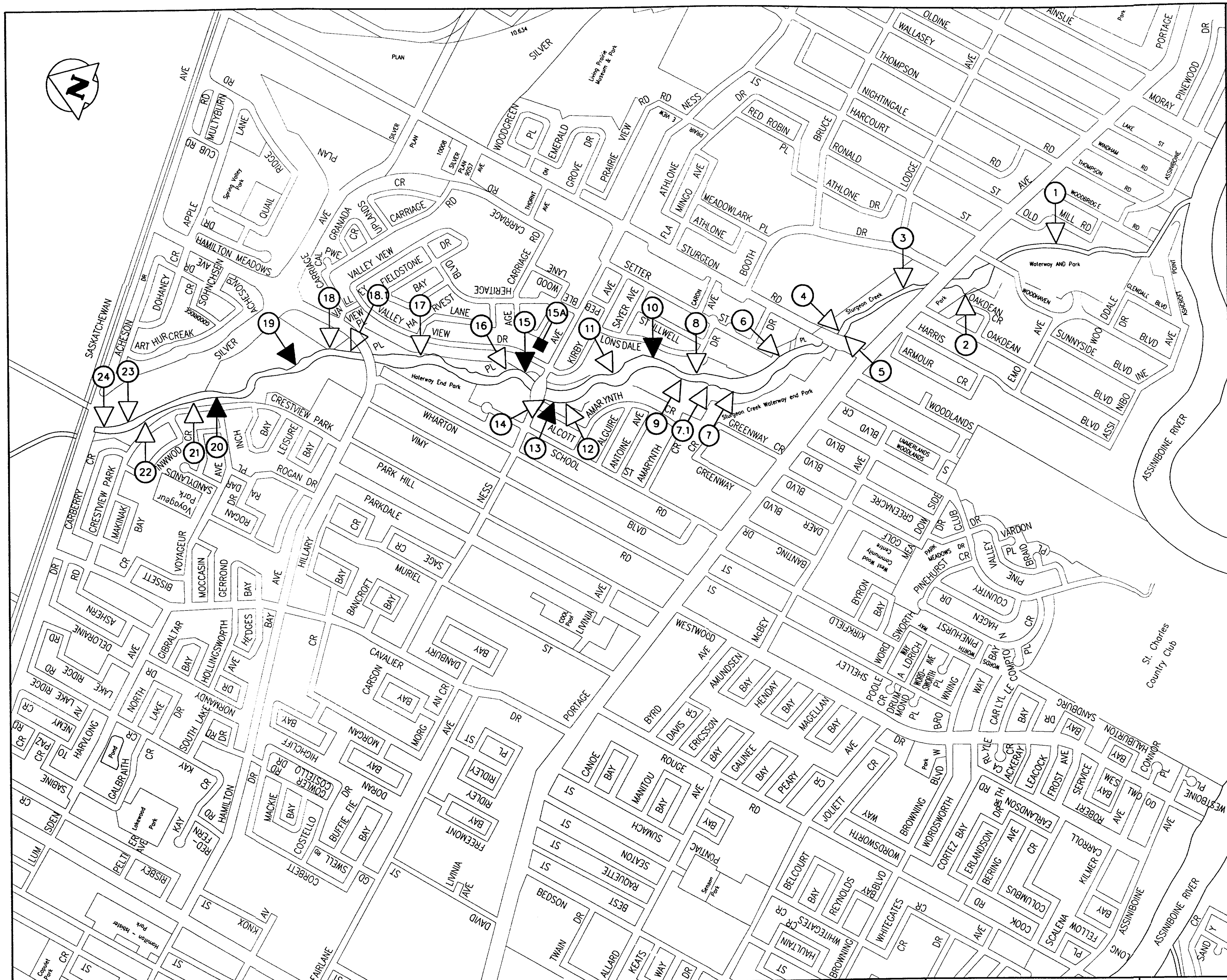
WORKS AND OPERATIONS DIVISION
WATER AND WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY

RIVER AND TRIBUTARY STREAM OUTFALL INVENTORY



DRAWING NUMBER	LOCATION	DESCRIPTION
M - 551	STURGEON CREEK (ST)	ASSINIBOINE RIVER TO SASKATCHEWAN AVENUE
M - 552	OMANDS CREEK (OM)	ASSINIBOINE RIVER TO NOTRE DAME AVENUE
M - 553	BUNNS CREEK (BU)	RED RIVER TO LAGIMODIERE BOULEVARD
M - 554	SEINE RIVER (SE)	RED RIVER TO GAREAU STREET
M - 555	SEINE RIVER (SE)	GUAY AVENUE TO BERRYDALE AVENUE
M - 556	SEINE RIVER (SE)	BERRYDALE AVENUE TO SOUTHGLEN BOULEVARD
M - 557	LASALLE RIVER (LS)	RED RIVER TO RUE DU MONASTERE
M - 558	ASSINIBOINE RIVER (AS)	HALL ROAD TO STURGEON CREEK
M - 559	ASSINIBOINE RIVER (AS)	STURGEON CREEK TO OMAND'S CREEK
M - 560	ASSINIBOINE RIVER (AS)	OMAND'S CREEK TO RED RIVER
M - 561	RED RIVER (RR)	LA SALLE RIVER TO FROBISHIRE ROAD
M - 562	RED RIVER (RR)	BRITANNICA ROAD TO BALTIMORE ROAD
M - 563	RED RIVER (RR)	METCALFE AVENUE TO MUNROE AVENUE
M - 564	RED RIVER (RR)	BREDIN DRIVE TO PERIMETER HIGHWAY
M - 566	RED RIVER FLOODWAY (FL)	KILDARE AVENUE TO NAVIN ROAD



OUTFALL ID. NO.	NAME	TYPE	SIZE
ST-1	OLD MILL RD.	LDS	400 DIA.
ST-2	OAKDEAN CRES.	LDS	300 DIA.
ST-3	BOOTH DR.	LDS	1850 DIA.
ST-4	STURGEON RD. (NORTH)	LDS	1500 DIA.
ST-5	STURGEON RD. (SOUTH)	LDS	1200 DIA.
ST-6	SETTER ST.	LDS	600 DIA.
ST-7	GREENWAY CRES. #1	LDS	600 DIA.
ST-7.1	GREENWAY CRES. #2	LDS	750 DIA.
ST-8	LONSDALE DR. #1	LDS	600 DIA.
ST-9	AMARYNTH CRES. #1	LDS	510 DIA.
ST-10	LONSDALE DR. #2	WWS	300 DIA.
ST-11	KIRBY DR.	LDS	600 DIA. & DITCH
ST-12	AMARYNTH CRES. #2	LDS	400 DIA.
ST-13	ALCOTT ST.	WWS	600 DIA.
ST-14	NESS AVE.	LDS	1900 DIA
ST-15	VALLEYVIEW DR. #1	WWS	600 DIA.
ST-15A	HERITAGE PUMPING STATION	WWS	
ST-16	VALLEYVIEW DR. #2	LDS	1050 & 125 DIA.
ST-17	HARVEST LANE	LDS	400 DIA.
ST-18	HAMILTON AVE. #1	LDS	1500 DIA.
ST-18.1	HAMILTON AVE. #2	LDS	400 DIA.
ST-19	SILVER AVE.	WWS	525 DIA.
ST-20	VOYAGEUR AVE.	WWS	600 DIA.
ST-21	CRESTVIEW PARK DR. (RETENTION POND DRAINAGE)	LDS	1675 DIA.
ST-22	CRESTVIEW PARK DR.	LDS	750 DIA.
ST-23	ACHESON DR.	LDS	400 DIA.
ST-24	SASKATCHEWAN AVE.	LDS	361 DIA.

LEGEND:

(15) ▶ WASTEWATER SEWER OVERFLOW OUTFALL (WWS)

(14) ▷ LAND DRAINAGE OUTFALL (LDS)

(15A) ■ LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

NOTE:
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B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY	CHECKED BY MD
DRAWN BY AP	APPROVED BY
HOR. SCALE: VERTICAL:	RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998	DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
—

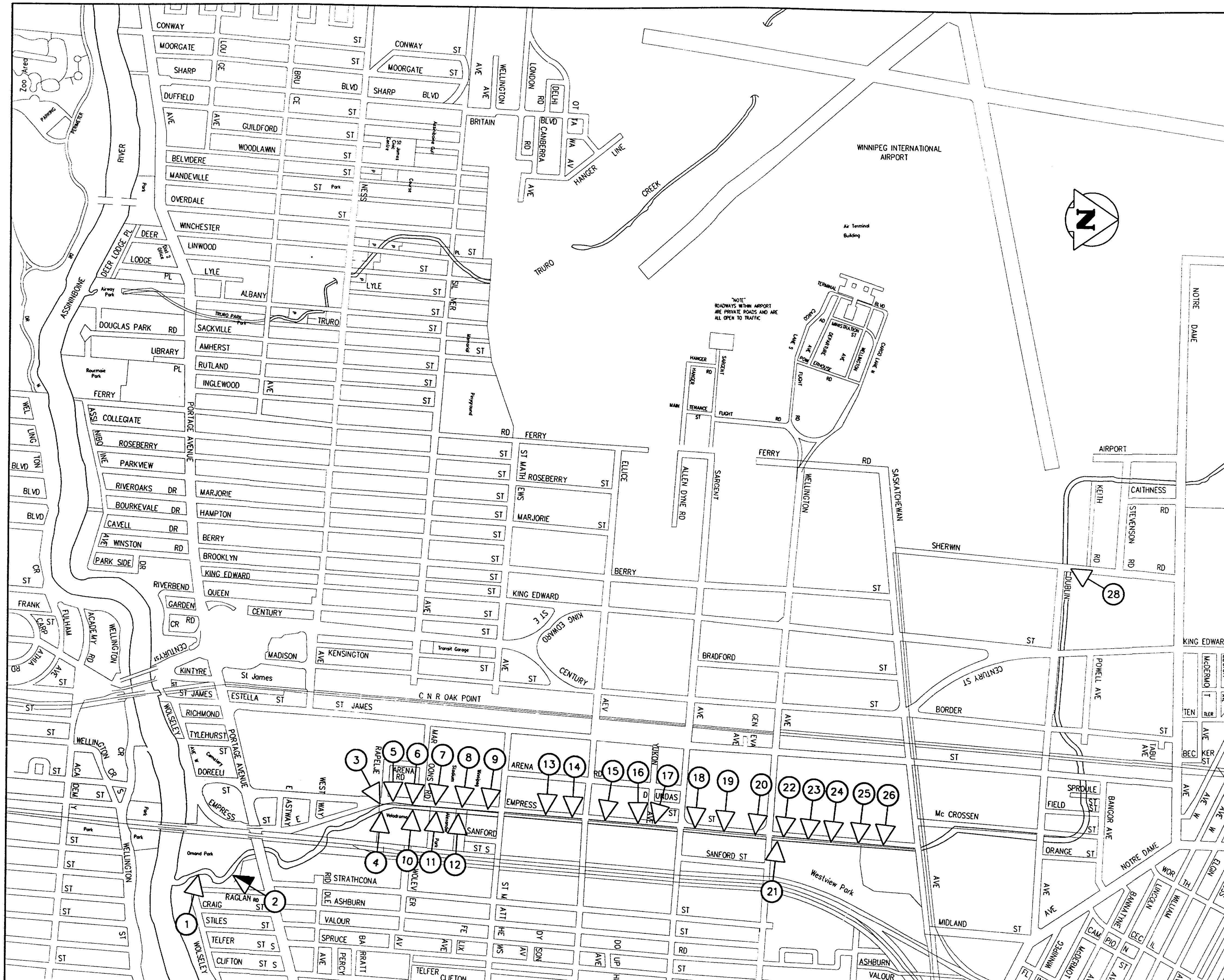
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
STURGEON CREEK
ASSINIBOINE RIVER TO SASKATCHEWAN AVE.

SHEET 1 OF 15

COMPUTER FILE NAME
M-551

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
OM-1	RAGLAN RD.	LDS	400 DIA.
OM-2	CLIFTON ST. OVERFLOW	CS	2700 DIA.
OM-3	EMPRESS ST. #1	LDS	750 DIA.
OM-4	VELODROME #1	LDS	380 DIA.
OM-5	EMPRESS ST. #2	LDS	300 DIA.
OM-6	EMPRESS ST. #3	LDS	300 DIA.
OM-7	EMPRESS ST. #4	LDS	300 DIA.
OM-8	EMPRESS ST. #5	LDS	300 DIA.
OM-9	EMPRESS ST. #6	LDS	300 DIA.
OM-10	VELODROME METER PIT	LDS	100 DIA.
OM-11	VELODROME #2	LDS	300 DIA.
OM-12	EMPRESS ST. #7	LDS	300 DIA.
OM-13	EMPRESS ST. #8	LDS	300 DIA.
OM-14	EMPRESS ST. #9	LDS	300 DIA.
OM-15	EMPRESS ST. #10	LDS	300 DIA.
OM-16	EMPRESS ST. #11	LDS	300 DIA.
OM-17	EMPRESS ST. #12	LDS	300 DIA.
OM-18	EMPRESS ST. #13	LDS	300 DIA.
OM-19	EMPRESS ST. #14	LDS	300 DIA.
OM-20	WESTVIEW PARK CHANNEL	LDS	
OM-21	EMPRESS ST. #15	LDS	300 DIA.
OM-22	EMPRESS ST. #16	LDS	300 DIA.
OM-23	EMPRESS ST. #17	LDS	300 DIA.
OM-24	EMPRESS ST. #18	LDS	300 DIA.
OM-25	EMPRESS ST. #19	LDS	300 DIA.
OM-26	EMPRESS ST. #20	LDS	300 DIA.
OM-28	ABANDONED	LDS	

LEGEND:

9 — LAND DRAINAGE OUTFALLS (LDS)

2 — COMBINED SEWER OVERFLOW (CS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

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CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

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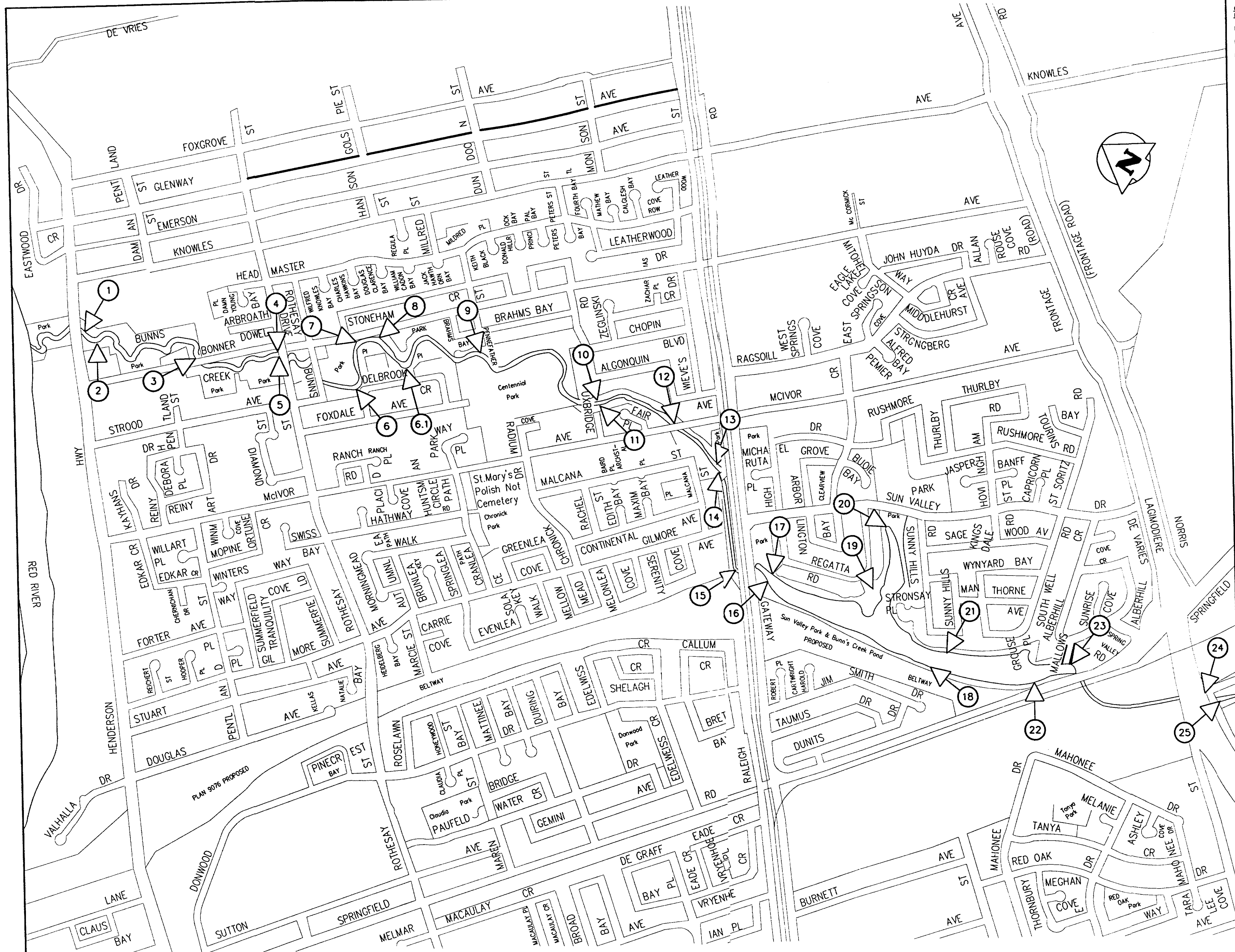
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
OMAND'S CREEK
ASSINIBOINE RIVER NORTH TO NOTRE DAME AVENUE

SHEET 2 OF 15
COMPUTER FILE NAME M-552
CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
BU-1	HENDERSON HWY. #1	LDS	1375 DIA.
BU-2	HENDERSON HWY. #2	LDS	1200 DIA.
BU-3	BONNER AVE. #1	LDS	525 DIA.
BU-4	ROTHESAY ST. N.	LDS	1200 DIA.
BU-5	ROTHESAY ST. S.	LDS	1200 DIA.
BU-6	DELBROOK CRES. #1	LDS	400 DIA.
BU-6.1	DELBROOK CRES. #2	LDS	600 DIA.
BU-7	BONNER AVE. #2	LDS	400 DIA.
BU-8	BONNER AVE. #3	LDS	375 DIA.
BU-9	PENNEFATHER ST.	LDS	1350 DIA.
BU-10	UXBRIDGE RD. N.	LDS	1200 DIA.
BU-11	UXBRIDGE RD. S.	LDS	900 DIA.
BU-12	McIVOR AVE.	LDS	400 DIA.
BU-13	RALEIGH ST. #1	LDS	400 DIA.
BU-14	RALEIGH ST. #2	LDS	750 DIA.
BU-15	RALEIGH ST. #3	LDS	750 DIA.
BU-16	GATEWAY RD.	LDS	800 DIA.
BU-17	REGATTA RD. #1	LDS	300 DIA.
BU-18	JIM SMITH DR.	LDS	1390x975
BU-19	REGATTA RD. #2	LDS	300 DIA.
BU-20	SUN VALLEY DR.	LDS	1800 DIA.
BU-21	SUNNY HILLS RD.	LDS	725 DIA.
BU-22	WPG. HYDRO TRANSMISSION LINE	LDS	2125 DIA.
BU-23	MALLOWS WAY	LDS	900 DIA.
BU-24	KILCONA REGIONAL PARK LAKES	LDS	DITCH
BU-25	LAGIMODIERE BLVD.	LDS	DITCH

LEGEND:

15 — LAND DRAINAGE OUTFALL (LDS)

LOCATION APPROVED UNDERGROUND STRUCURES

SUPV. U/G STRUCTURES COMMITTEE ATE

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THUNDER BAY (807) 345-2233

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CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY

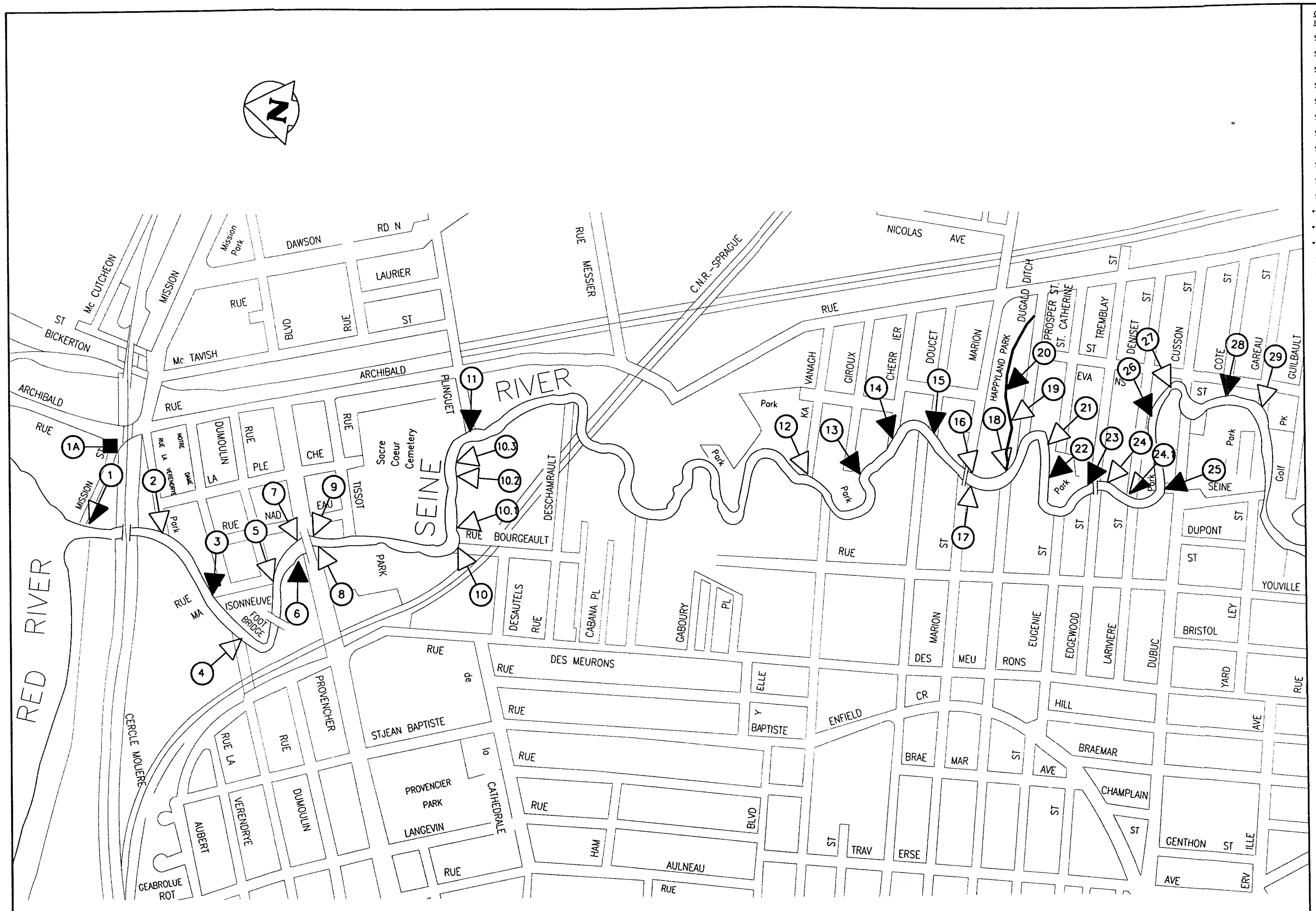
BUNNS CREEK

RED RIVER TO LAGIMODIERE BLVD.

SHEET 3 OF 15

COMPUTER FILE NAME **M-553**

CITY DRAWING NUMBER



LEGEND:

44 LAND DRAINAGE OUTFALL (LDS)

44 WASTEWATER SEWER OVERFLOW OUTFALL (WWS)

45 COMBINED SEWER OUTFALL (CS)

1A FLOOD PUMPING STATION

OUTFALL ID. NO.	NAME	TYPE	SIZE
SE-1	MISSION FPS	CS	2600 DIA.
SE-1A	MISSION ST. - LIFT STATION	CS	300 DIA.
SE-2	RUE LAVERENDRYE	LDS	600 DIA.
SE-3	RUE NOTRE DAME E.	WWS	300 DIA.
SE-4	RUE NOTRE DAME W.	LDS	1220 DIA.
SE-5	RUE DUMOULIN	WWS	600 DIA.
SE-6	PROVENCHER BLVD. #1	WWS	300 DIA.
SE-7	PROVENCHER BLVD. #2	LDS	300 DIA.
SE-8	PROVENCHER BLVD. BRIDGE DRAINS	LDS	2-150 DIA.
SE-9	PROVENCHER BLVD. #3	LDS	300 DIA.
SE-10	RUE BOURGEAULT	LDS	450 DIA.
*SE-10.1	WESTEEL #1	LDS	400 DIA.
*SE-10.2	WESTEEL #2	LDS	450 DIA.
*SE-10.3	WESTEEL #3	LDS	300 DIA.
SE-11	RUE PLINGUET	CS	300 DIA.
SE-12	KAVANAGH ST.	LDS	750 DIA.
SE-13	GIROUX ST.	WWS	300 DIA.
SE-14	CHERRIER ST.	WWS	300 DIA.
SE-15	DOUCET ST.	WWS	300 DIA.
SE-16	MARION ST.	LDS	300 DIA.
SE-17	MARION ST. BRIDGE ABUTMENT	LDS	5-100 DIA.
SE-18	DUGALD DITCH ENTERS	LDS	
SE-19	DUGALD DITCH S. #1	LDS	300 DIA.
SE-20	DUGALD DITCH S. #2	WWS	300 DIA.
SE-21	ST. CATHERINE ST. #1	LDS	600 DIA.
SE-22	ST. CATHERINE ST. #2	WWS	300 DIA.
SE-23	TREMBLAY ST.	WWS	300 DIA.
SE-24	TREMBLAY ST. FOOTBRIDGE	LDS	CHANNELS
SE-24.1	DENISET ST. #1	CS	300 DIA.
SE-25	DUBUC ST.	WWS	300 DIA.
SE-26	DENISET ST. #2	WWS	300 DIA.
SE-27	EVANS AVE.	LDS	1067 DIA.
SE-28	COTE ST.	WWS	450 DIA.
SE-29	GAREAU ST.	LDS	800 DIA.

* - PRIVATE OUTFALL

LOCATION APPROVED
UNDERGROUND STRUCTURES

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KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

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DATE AUGUST 20, 1998	DATE

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CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY

SEINE RIVER

RED RIVER TO GAREAU ST.

SHEET 4 OF 15

COMPUTER FILE NAME M-554

CITY DRAWING NUMBER

OUTFALL ID. NO.	NAME	TYPE	SIZE
SE-30	GUAY AVE.	LDS	750 DIA.
SE-30.1	EGERTON RD.	LDS	900 DIA.
SE-31	BLENHEIM AVE.	LDS	1060 DIA.
SE-32	IMPERIAL AVE.	LDS	750 DIA.
SE-33	HUMBOLT AVE.	LDS	900 DIA.
SE-34	RUE ARCHIBALD ST.	LDS	2700 DIA.
SE-34.1	BIBEAU DRAIN ENTERS	LDS	CHANNEL
SE-35	AVONDALE RD.	LDS	750 DIA.
SE-36	COMANCHE RD.	WWS	600 DIA.
SE-37	FERMOR AVE.	LDS	600 DIA.
SE-38	NIAKWA RD. #1	LDS	450 DIA.
SE-38.1	NIAKWA RD. #2	LDS	450 DIA
SE-39	MORROW AVE.	LDS	750 DIA.
SE-40	FERNWOOD AVE.	LDS	750 DIA.
SE-41	CLAYTON DR.	LDS	525 DIA.
SE-42	BERRYDALE AVE.	LDS	600 DIA.
SE-43	SOUTHBRIDGE DR.	LDS	900 DIA.

LEGEND:

44 LAND DRAINAGE OUTFALLS (LDS)

36 WASTEWATER SEWER OVERFLOW OUTFALL (WWS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

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THUNDER BAY (807) 345-2233

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ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY

SEINE RIVER

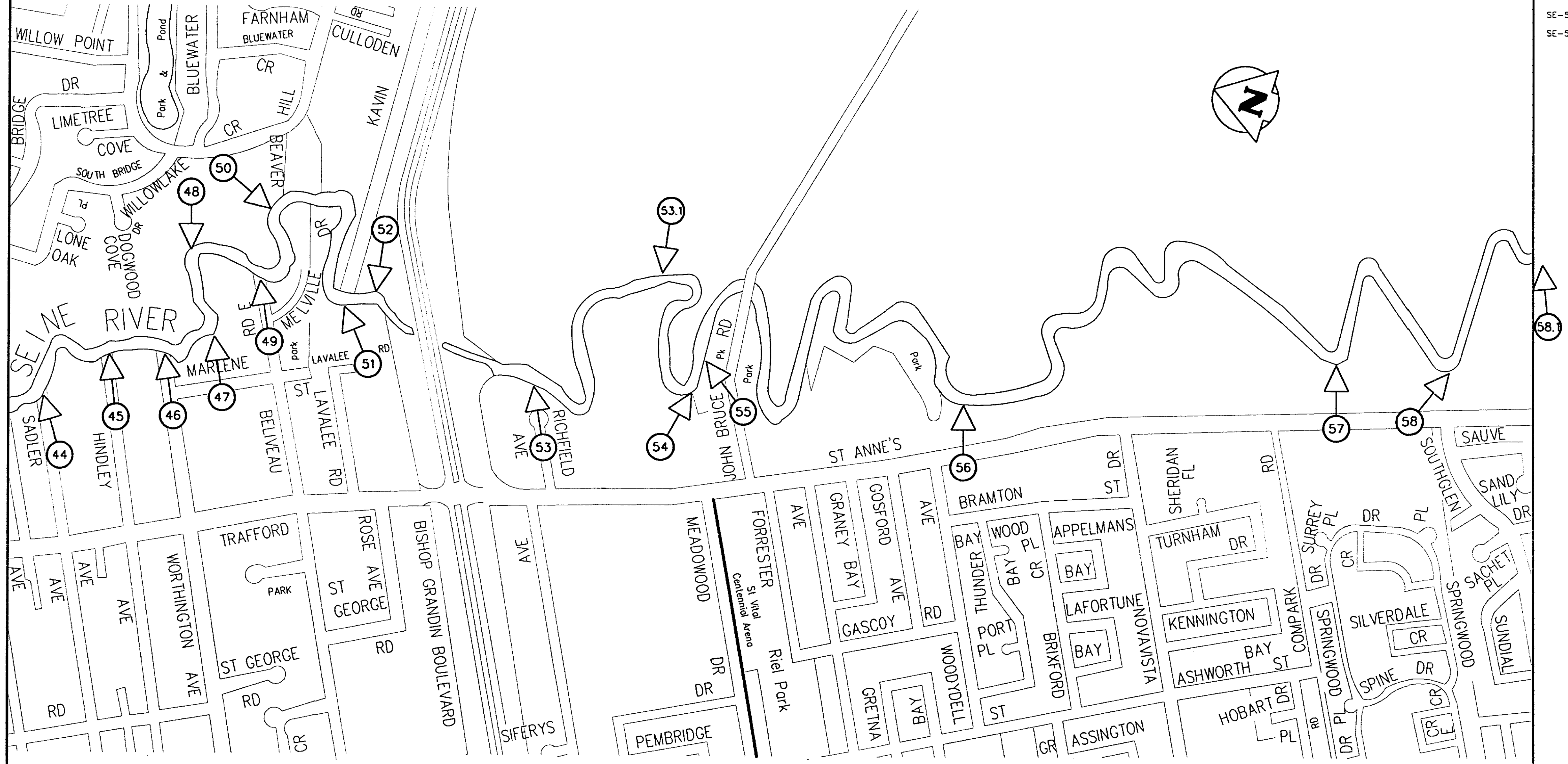
GUAY AVE. TO BERRYDALE AVE.

SHEET 5 OF 15

COMPUTER FILE NAME M-555

CITY DRAWING NUMBER

OUTFALL ID. NO.	NAME	TYPE	SIZE
SE-44	SADLER AVE.	LDS	1050 DIA.
SE-45	HINDLEY AVE.	LDS	525 DIA.
SE-46	WORTHINGTON AVE.	LDS	750 DIA.
SE-47	MARLENE ST.	LDS	525 DIA.
SE-48	WILLOWLAKE CR.	LDS	1525 DIA.
SE-49	BELIVEAU RD.	LDS	1050 DIA.
SE-50	N. OF BEAVERHILL BLVD.	LDS	900 DIA.
SE-51	LAVALEE RD.	LDS	1200 DIA.
SE-52	BISHOP GRANDIN BLVD.	LDS	800 DIA. & DITCH
SE-53	RICHFIELD AVE.	LDS	1200 DIA.
SE-53.1	ROYALWOOD SUBDIVISION	LDS	450 DIA.
SE-54	PUBLIC LANE E. OF MEADOWOOD DR.	LDS	1200 DIA.
SE-55	N. OF JOHN BRUCE RD.	LDS	1200 DIA.
SE-56	WOODYDELL AVE.	LDS	1200 DIA.
SE-57	COMPARK RD.	LDS	1400 DIA.
SE-58	SOUTHGLEN DR.	LDS	1600 DIA.
SE-58.1	ST. ANNES RD.	LDS	2-1600 DIA.



LEGEND:

44 LAND DRAINAGE OUTFALL (LDS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

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WINNIPEG (204) 896-1209
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VERTICAL:
RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998
DATE

ENGINEER'S SEAL

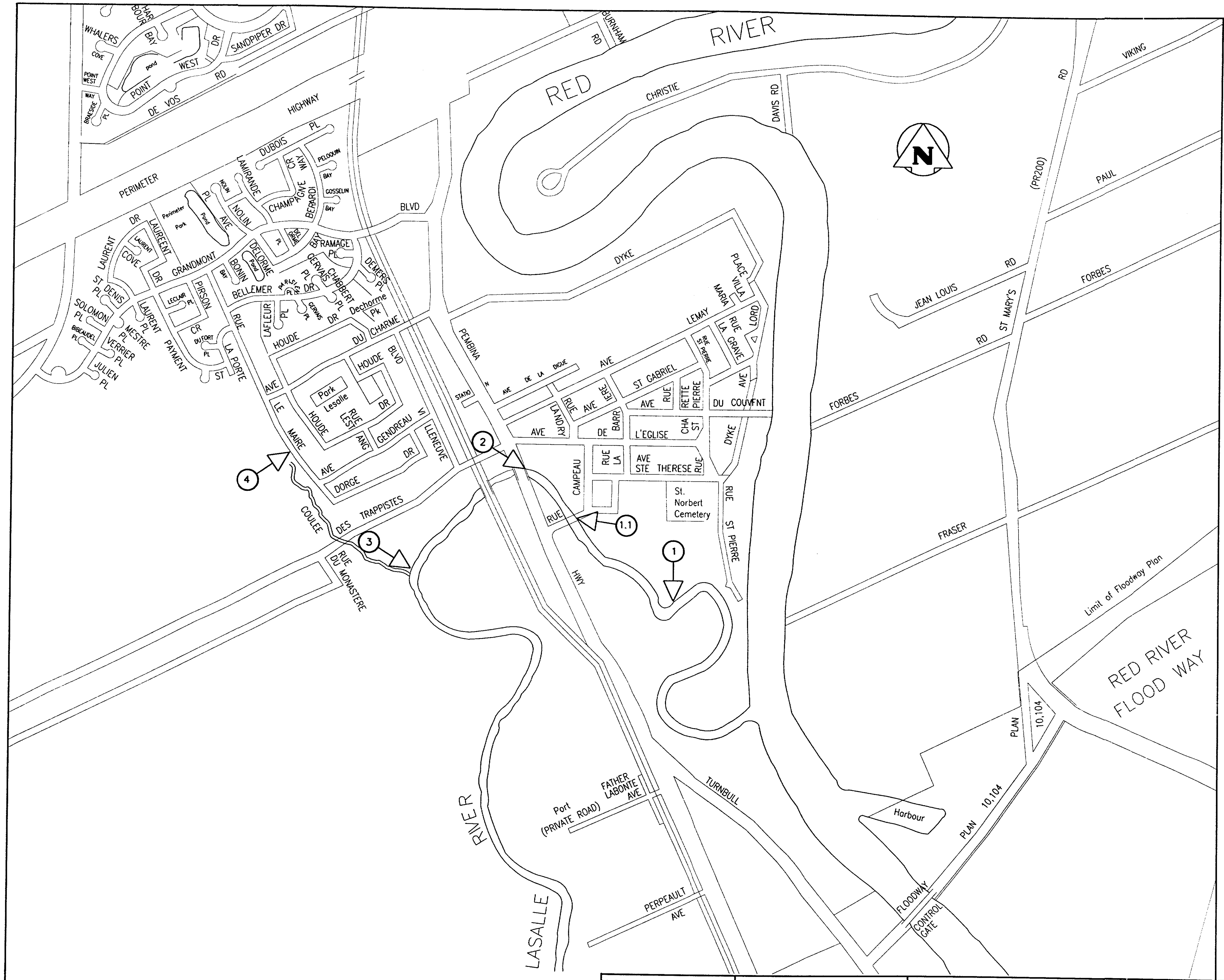
CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
SEINE RIVER
BERRYDALE AVE. TO SOUTHGLEN BLVD.

SHEET 6 OF 15
COMPUTER FILE NAME M-556
CITY DRAWING NUMBER

OUTFALL ID. NO.	NAME	TYPE	SIZE
LS-1	RUE ST. PIERRE	LDS	300 DIA.
LS-1.1	RUE CAMPEAU	LDS	300 DIA.
LS-2	RUE DES TRAPPISTES	LDS	450 DIA.
LS-3	COULEE INTO LA SALLE RIVER	LDS	CHANNEL
LS-4	RUE LA MAIRE	LDS	1000 DIA.



LEGEND:

(3) ▷ LAND DRAINAGE OUTFALL (LDS)

LOCATION APPROVED UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP — CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY	CHECKED BY MD
DRAWN BY AP	APPROVED BY
HOR. SCALE: VERTICAL:	RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998	DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY

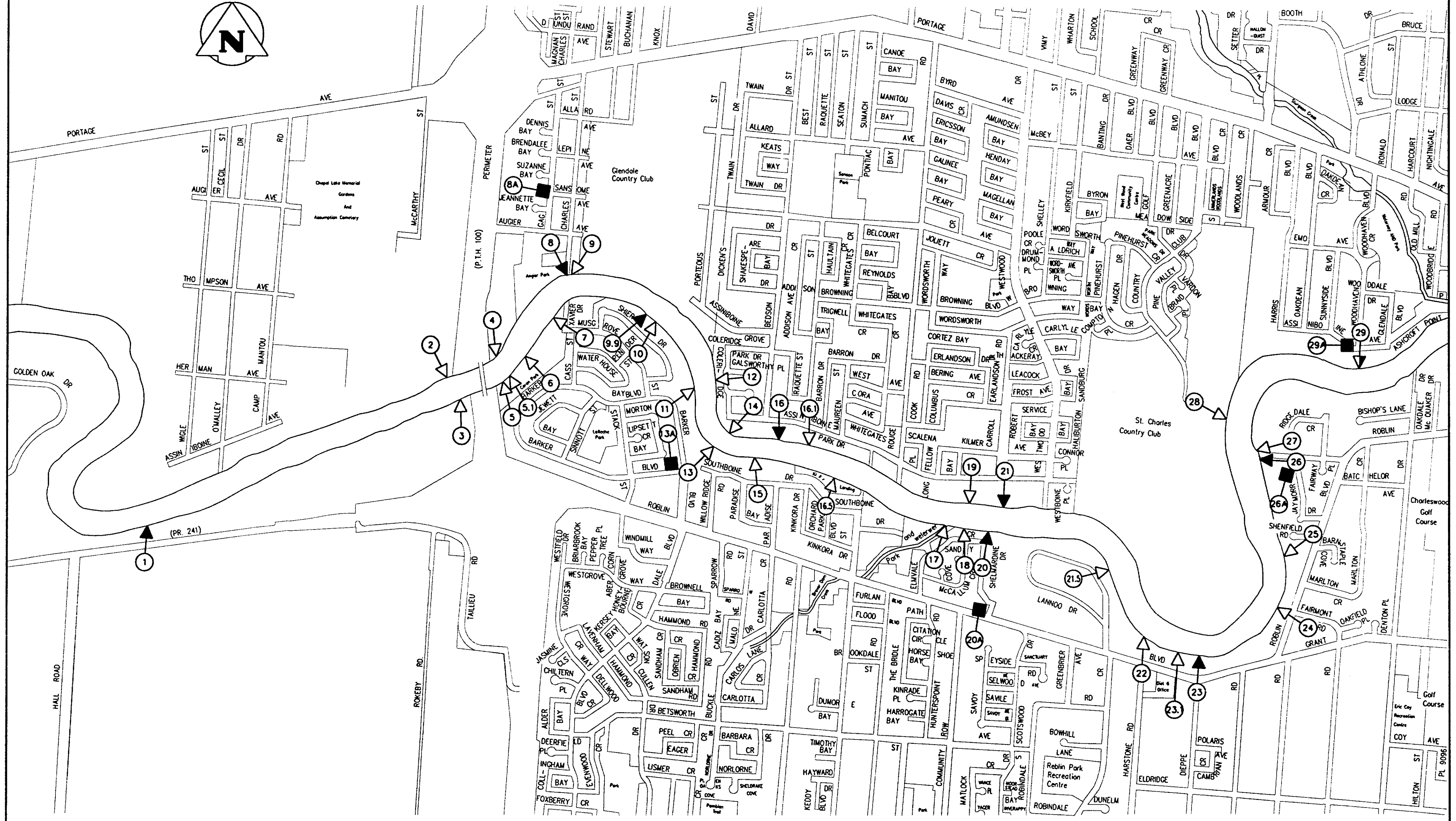
LaSALLE RIVER

RED RIVER TO RUE DU MONASTERE

SHEET 7 OF 15

COMPUTER FILE NAME M-557

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
AS-1	W.E.W.P.C.C. OUTFALL	TE	1500 DIA.
*AS-2	P.T.H. 100 W. SIDE #1	LDS	1400 DIA.
*AS-3	P.T.H. 100 W. SIDE #2	LDS	1350 DIA.
*AS-4	P.T.H. 100 E. SIDE #1	LDS	800 DIA.
*AS-5	P.T.H. 100 E. SIDE #2	LDS	1200 DIA.
*AS-5.1	P.T.H. 100 E. SIDE #3	LDS	1500 DIA.
AS-6	BARKER SPS	LDS	150 DIA.
AS-7	CARON PARK	LDS	150 DIA.
AS-8	ST. CHARLES ST.	WWS	250 DIA.
AS-8A	ST. CHARLES ST. LIFT STATION	WWS	
AS-9	ST. CHARLES ST. #2	LDS	900 DIA.
AS-9.9	SHIER DR.	WWS	250 DIA.
AS-10	PENDER ST.	LDS	900 DIA.
AS-11	BARKER BLVD.	LDS	1075 DIA.
AS-12	GALSWORTHY PL.	LDS	450 DIA.
AS-13	WILLOW RIDGE RD.	LDS	1800 DIA.
AS-13A	BARKER BLVD. LIFT STATION OVERFLOW	WWS	
AS-14	COLERIDGE PARK DR. SOUTH	LDS	450 DIA.
AS-15	PARADISE BAY	LDS	600 DIA.
AS-16	ABANDONED	WWS	450 DIA.
AS-16.1	RAQUETTE ST.	LDS	1800 DIA.
AS-16.5	ORCHARD PARK	LDS	600 DIA.
AS-17	BEAVER DAM CREEK ENTERS	LDS	
AS-18	McCALLUM CRESC.	LDS	1350 DIA.
AS-19	CARROLL RD.	LDS	1800 DIA.
AS-20	SHELMARDINE DR.	WWS	300 DIA.
AS-20A	COMMUNITY ROW LIFT STATION OVERFLOW	WWS	
AS-21	CARROLL RD. #2	WWS	300 DIA.
AS-21.5	LANNOO DR.	LDS	575x900
AS-22	HARSTONE RD.	LDS	450 DIA.
AS-23	DIEPPE RD. #2	WWS	900 DIA.
AS-23.1	DIEPPE RD. #1	LDS	600 DIA.
AS-24	FAIRMONT RD.	LDS	2500 DIA.
AS-25	SHENFIELD RD.	LDS	450 DIA.
AS-26	RIDGEDALE S.P.S.	WWS	250 DIA.
AS-26A	RIDGEDALE LIFT STATION	WWS	
AS-27	RIDGEDALE CRESC.	LDS	450 DIA.
AS-28	COUNTRY CLUB BLVD.	LDS	900 DIA.
AS-29	WOODHAVEN BLVD.	CS	450 DIA.
AS-29A	WOODHAVEN LIFT STATION	WWS	

* – PRIVATE OUTFALL

LEGEND:

- 33 LAND DRAINAGE (LDS)
- 34 WASTEWATER OVERFLOW (WWS)
- 58 COMBINED SEWER OVERFLOW (CS)
- 8A LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE   DATE

NOTE:
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B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY	CHECKED BY MD
DRAWN BY AP	APPROVED BY
HOR. SCALE: VERTICAL:	RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998	DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. –

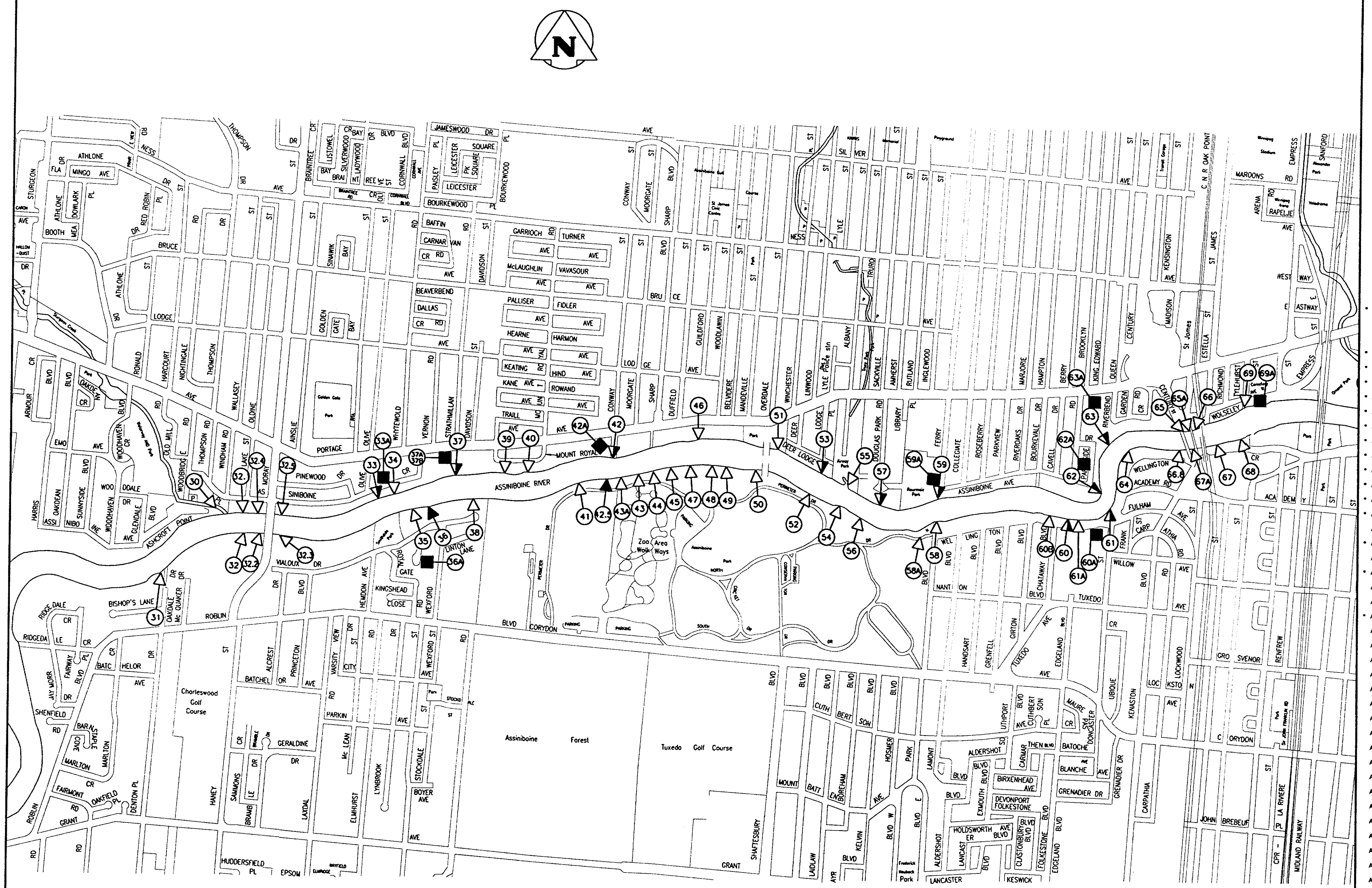
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
ASSINIBOINE RIVER
HALL ROAD TO STURGEON CREEK

SHEET 8 OF 15

COMPUTER FILE NAME M-558

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
AS-30	STURGEON CREEK ENTERS	LDS	CHANNEL
AS-31	OAKDALE DR.	LDS	600 DIA.
AS-32	McQUAKER DR.	LDS	1050 DIA.
AS-32.1	ASSINIBOINE CRES.	LDS	300 DIA.
AS-32.2	CHARLESWOOD BRIDGE SW	LDS	250 DIA.
AS-32.3	CHARLESWOOD BRIDGE SE	LDS	250 DIA.
AS-32.4	CHARLESWOOD BRIDGE NW	LDS	250 DIA.
AS-32.5	CHARLESWOOD BRIDGE NE	LDS	250 DIA.
AS-33	OLIVE ST. #1	CS	750 DIA.
AS-33A	OLIVE ST. LIFT STATION	WWS	
AS-34	OLIVE ST. #2	LDS	2200 DIA.
AS-35	VIALOUX DR.	LDS	1500 DIA.
AS-36	WEXFORD S.P.S.	CS	250 DIA.
AS-36A	WEXFORD LIFT STATION	CS	250 DIA.
AS-37	STRATHMILLAN RD.	CS	900 DIA.
AS-37A	STRATHMILLAN COMMUNATOR CHAMBER OVERFLOW	CS	
AS-37B	STRATHMILLAN GATE CHAMBER	CS	300 DIA.
AS-38	VIALOUX DR. CUL-DE-SAC	LDS	750 DIA.
AS-39	MOUNT ROYAL CRES. #1	LDS	150 DIA.
AS-40	MOUNT ROYAL CRES. #2	LDS	250 DIA.
* AS-41	PERIMETER DR.-ASSINIBOINE PARK #1	LDS	DITCHDRAIN
AS-42	CONWAY CS	CS	2500 DIA.
AS-42A	CONWAY LIFT STATION	CS	
* AS-42.5	PERIMETER DR.-ASSINIBOINE PARK #2	CS	300 DIA.
* AS-43	N. PERIMETER DR. PUMPING STATION	LDS	300 DIA.
* AS-43A	ASSINIBOINE PARK DITCH DRAIN	LDS	400 DIA.
* AS-44	N. PERIMETER DR.-ASSINIBOINE PARK #1	LDS	300 DIA.
* AS-45	N. PERIMETER DR.-ASSINIBOINE PARK #2	LDS	450 DIA.
* AS-46	WOODLAWN ST.	LDS	300 DIA.
* AS-47	N. PERIMETER DR.-ASSINIBIONE PARK #3	LDS	150 DIA.
* AS-48	N. PERIMETER DR.-ASSINIBOINE PARK #4	LDS	150 DIA.
* AS-49	N. PERIMETER DR.-ASSINIBOINE PARK #5	LDS	150 DIA.
* AS-50	ASSINIBOINE PARK W. OF FOOT BRIDGE	LDS	150 DIA.
* AS-51	OVERDALE ST.	LDS	400 DIA.
* AS-52	ASSINIBOINE PARK #2	LDS	200 DIA.
AS-53	DEER LODGE PL.	CS	300 DIA.
* AS-54	ASSINIBOINE PARK #3	LDS	150 DIA.
AS-55	TRURO CREEK ENTERS	LDS	CHANNEL
* AS-56	ASSINIBOINE PARK #4	LDS	DITCH
AS-57	DOUGLAS PARK RD.	CS	300 DIA.
AS-58	PARK BLVD.	LDS	2400 DIA.
* AS-58A	ASSINIBOINE PARK DITCH DRAIN #2	LDS	300 DIA.
AS-59	FERRY RD.	CS	1800 DIA.
AS-59A	FERRY RD. PUMPING STATION	CS	
AS-60	CHATAWAY BLVD.	CS	900 DIA.
AS-60A	CHATAWAY BLVD. LIFT STATION	WWS	
AS-60B	CHATAWAY BLVD. #2	LDS	600 DIA.
AS-61	DONCASTER ST.	CS	2250 DIA.
AS-61A	EDGELAND BLVD.	LDS	400 DIA.
AS-62	PARKSIDE DR.	CS	750 DIA.
AS-62A	PARKSIDE DR. LIFT STATION	CS	
AS-63	RIVERBEND CRES.	CS	2250 DIA.
AS-63A	RIVERBEND LIFT STATION	CS	
AS-64	WELLINGTON CRES. #1	LDS	300 DIA.
AS-65	ST.JAMES UNDERPASS	LDS	900 DIA.
AS-65A	ROUTE 90 OVERPASS	LDS	300 DIA.
AS-66	KING EDWARD ST.	LDS	650 DIA.
AS-66.8	WELLINGTON CRES. #2	LDS	450 DIA.
AS-67	WELLINGTON CRES. AT CNR BRIDGE	LDS	450 DIA.
AS-67A	ROUTE 90 BRIDGE	LDS	450 DIA.
AS-68	WELLINGTON CRES. #3	LDS	500 DIA.
AS-69	TYLEHURST ST.	CS	2250 DIA.
AS-69A	TYLEHURST LIFT STATION	CS	

* – PRIVATE OUTFALL

LEGEND:

33 — LAND DRAINAGE (LDS)

36 — WASTEWATER OVERFLOW (WWS)

58 — COMBINED SEWER OVERFLOW (CS)

58C — LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

NOTE:
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B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY

CHECKED BY MD

DRAWN BY AP

APPROVED BY

HOR. SCALE:
VERTICAL:

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DATE AUGUST 20, 1998

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ENGINEER'S SEAL

CONSULTANT DRAWING NO. –

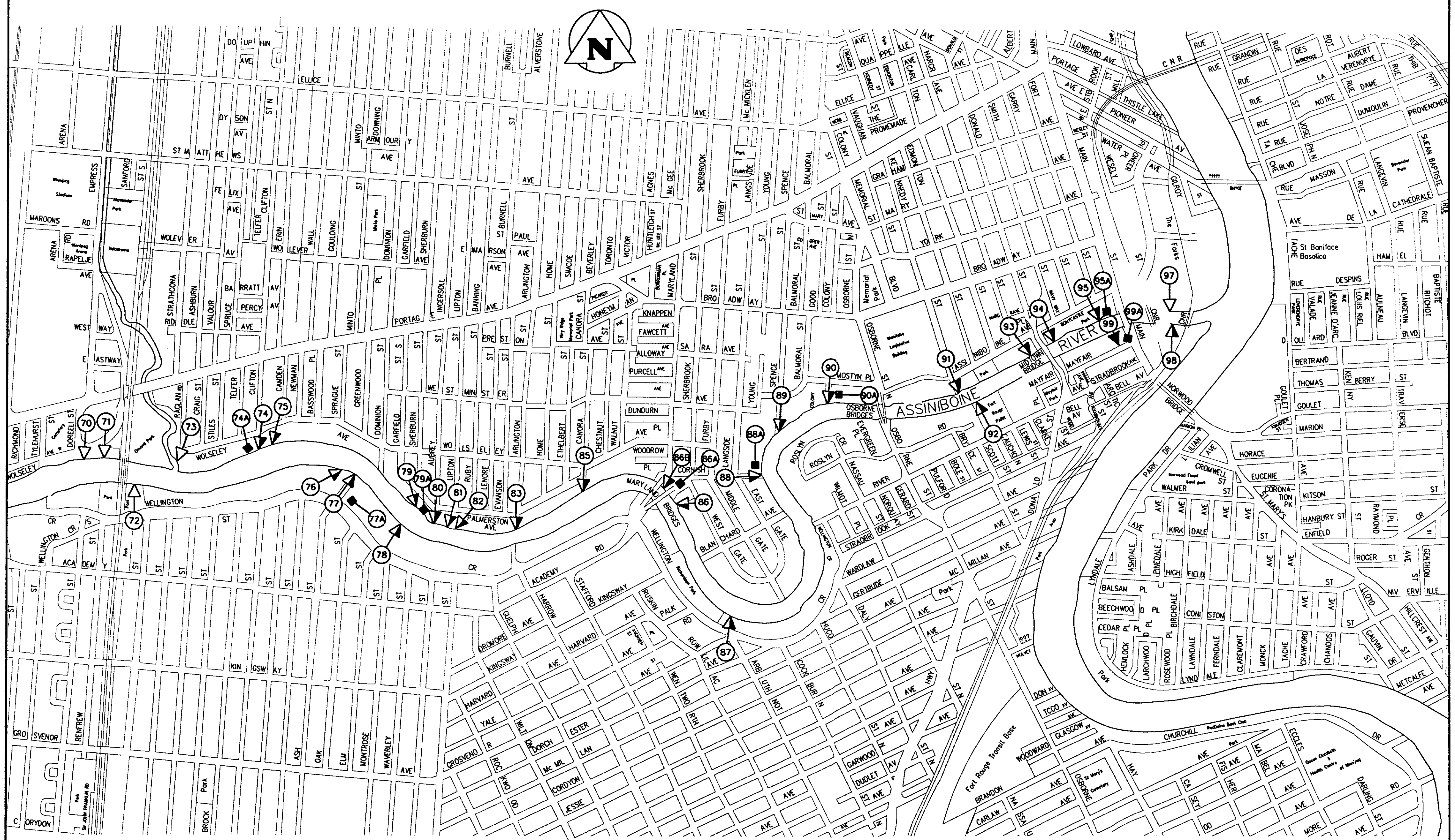
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
ASSINIBOINE RIVER
STURGEON CREEK TO OMAND'S CREEK

SHEET 9 OF 15

COMPUTER FILE NAME M-559

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
AS-70	EMPRESS ST. #1	LDS	300 DIA.
AS-71	EMPRESS ST. #2	LDS	300 DIA.
AS-72	RENFREW ST.	LDS	2400 DIA.
AS-73	OMAND'S CREEK ENTERS	LDS	CHANNEL
AS-74	CLIFTON ST. FPD	CS	2100 DIA.
AS-74A	CLIFTON LIFT STATION OVERFLOW	CS	
AS-75	CLIFTON ST.	CS	2300x2900
AS-76	ASH ST. FPS	CS	2100 DIA.
AS-77	ASH ST.	CS	3048x2900
AS-77A	ASH LIFT STATION OVERFLOW	CS	
AS-78	ELM ST.	CS	750 DIA.
AS-79	AUBREY ST.	CS	2900 DIA.
AS-79A	AUBREY LIFT STATION OVERFLOW	CS	
AS-80	AUBREY ST. FPS	CS	2100x2850
AS-81	RUBY ST. #1	CS	2100 DIA.
AS-82	RUBY ST. #2	CS	2700 DIA.
AS-83	ARLINGTON ST.	CS	375 DIA.
AS-85	CANORA ST.	CS	1975 DIA.
AS-86	CORNISH AVE. FPS	CS	1600 DIA.
AS-86A	CORNISH ST. LIFT STATION	CS	
AS-86B	MARYLAND ST.	CS	600 DIA.
AS-87	ARBUTHNOT ST.	CS	1400 DIA.
AS-88	CORNISH AVE.	CS	1500 DIA.
AS-88A	CORNISH LIFT STATION	CS	
AS-89	SPENCE ST.	CS	2700 DIA.
AS-90	COLONY ST.	CS	1800 DIA.
AS-90A	COLONY ST. FPS	CS	
AS-91	KENNEDY ST.	CS	750 DIA.
AS-92	FORT ROUGE PARK	CS	2400 DIA.
AS-93	HARGRAVE ST.	CS	700 DIA.
AS-94	DONALD ST.	CS	1900 DIA.
AS-95	ASSINIBOINE AVE. - FPD	CS	1200 DIA.
AS-95A	ASSINIBOINE AVE. - LIFT STATION	CS	
AS-97	THE FORKS E. OF C.N.R. BRIDGE	LDS	1200 DIA.
AS-98	THE FORKS E. OF C.N.R. BRIDGE (ABANDONED)	CS	1500x1000
AS-99	MAYFAIR AVE.	WWS	1200 DIA.
AS-99A	MAYFAIR AVE. - LIFT STATION	CS	

LEGEND:

33 — LAND DRAINAGE (LDS)
34 — WASTEWATER OVERFLOW (WWS)
58 — COMBINED SEWER OVERFLOW (CS)
74A — LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

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WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

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ENGINEER'S SEAL

CONSULTANT DRAWING NO.
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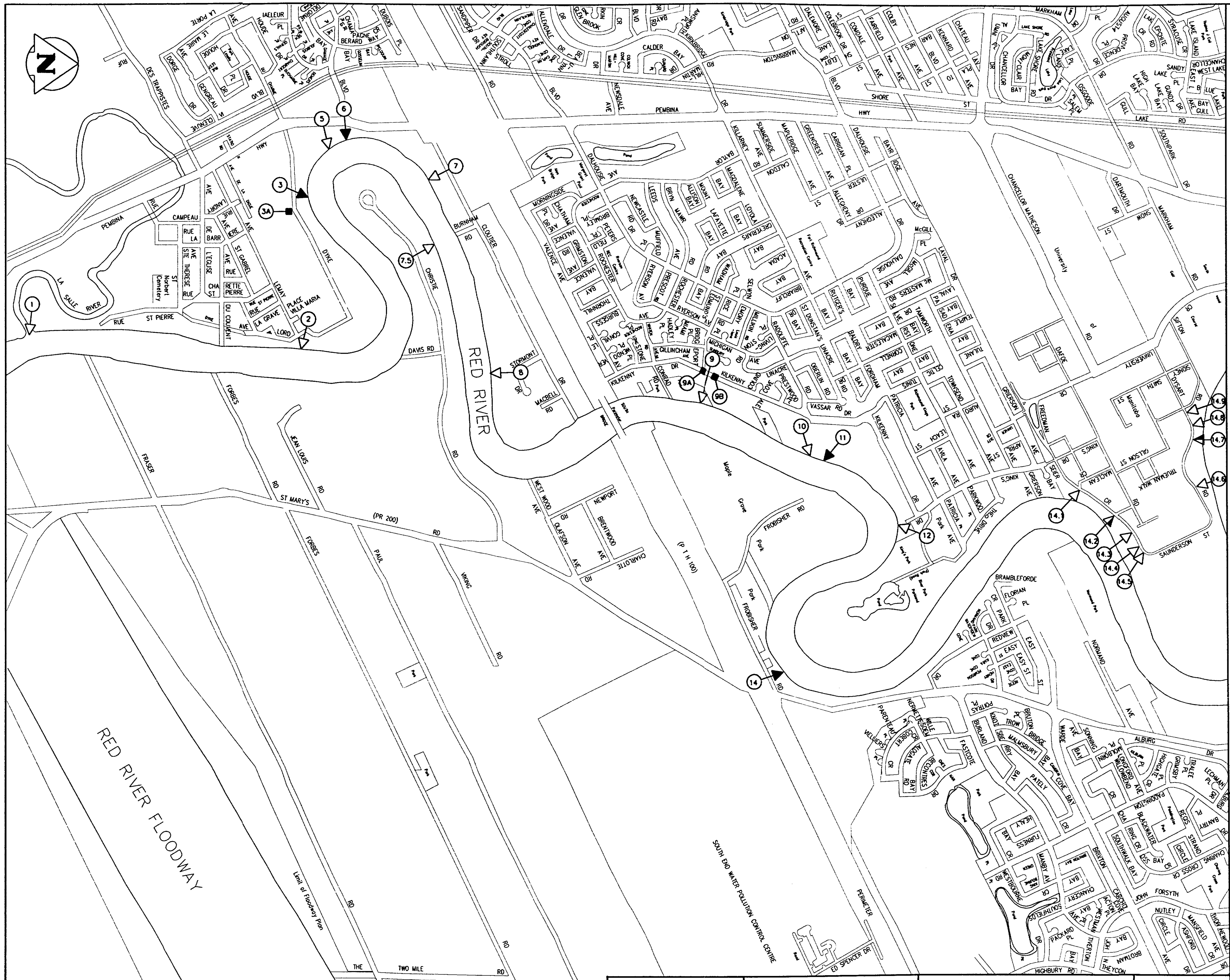
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION
AND MAINTENANCE STUDY
ASSINIBOINE RIVER
OMAND'S CREEK TO RED RIVER

SHEET 10 OF 15

COMPUTER FILE NAME
M-560

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
RR-1	LA SALLE RIVER ENTERS	LDS	CHANNEL
RR-2	LEMAY AVE.	LDS	900 DIA.
RR-3	ST. NORBERT X-KALAY LIFT STATION OVERFLOW	SANITARY	300 DIA.
RR-3A	ST. NORBERT X-KALAY LIFT STATION	SANITARY	
RR-4		DELETED	
RR-5	BEAUJOULAIS CREEK ENTERS	LDS	
RR-6	GRANDMONT BLVD.	SANITARY	750 DIA.
RR-7	CLOUTIER DR.	LDS	1800 DIA.
RR-7.5	CHRISTIE RD.	LDS	CHANNEL
RR-8	STORMONT DR.	LDS	400 DIA.
RR-9	RICE PLACE	LDS	1500 DIA.
RR-9A	KILKENNY DR. WASTEWATER SEWER OVERFLOW	LDS	
RR-9B	KILKENNY LIFT STATION	SANITARY	100 DIA.
RR-10	RADCLIFFE #1	LDS	1200 DIA.
RR-11	RADCLIFFE #2	WWS	750 DIA.
RR-12	KINGS DR.	LDS	1500 DIA.
RR-14	S.E.W.P.C.C. OUTFALL	TE	1800 DIA.
* RR-14.1	FREEDMAN CR. #1	LDS	
* RR-14.2	FREEDMAN CR. #2	CS	
* RR-14.3	SAUNDERSON ST. #1	LDS	
* RR-14.4	SAUNDERSON ST. #2	LDS	
* RR-14.5	SAUNDERSON ST. #3	LDS	
* RR-14.6	SIFTON RD. #1	LDS	
* RR-14.7	SIFTON RD. #2	CS	
* RR-14.8	SIFTON RD. #3	LDS	
* RR-14.9	SIFTON RD. #4	LDS	

* - PRIVATE OUTFALL

LEGEND:

33 LAND DRAINAGE (LDS)
34 WASTEWATER OVERFLOW (WWS)
58 COMBINED SEWER OVERFLOW (CS)
9B LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

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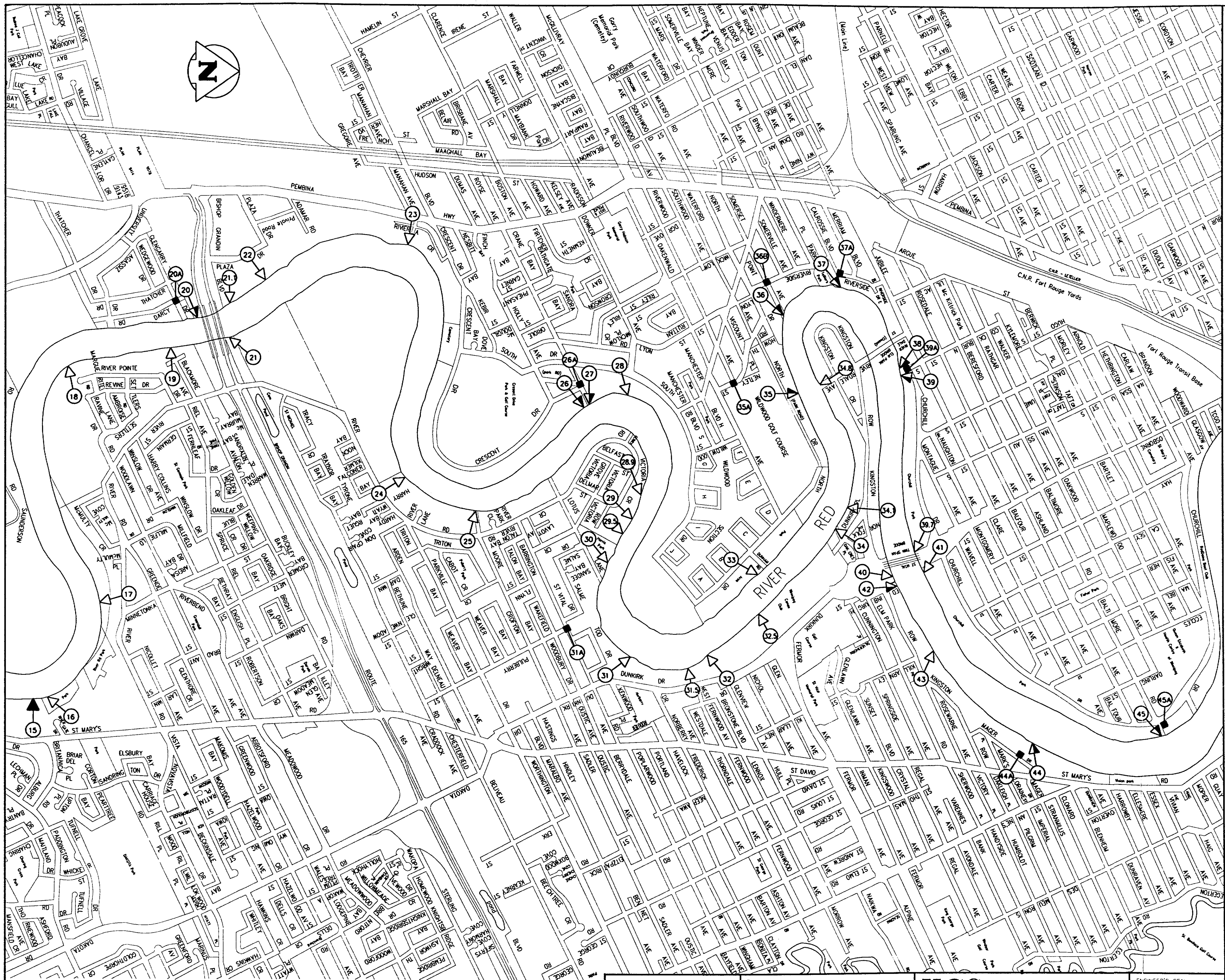
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER
LaSALLE RIVER TO FROBISHER ROAD

SHEET 11 OF 15
COMPUTER FILE NAME M-561
CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
RR-15	RIVERGATE DR.	WWS	1350 DIA.
RR-15A	S. ST. VITAL SRB CONTROL CHAMBER		
RR-16	ST. MARY'S RD.	LDS	2280 DIA.
RR-17	MINNETONKA ST.	LDS	2100 DIA.
RR-18	RIVER POINTE PL.	LDS	1050 DIA.
RR-19	BANNING RD.	LDS	1370 DIA.
RR-20	DARCY DR.	CS	2200 DIA.
RR-20A	DARCY DR.	CS	
RR-21	BISHOP GRANDIN BLVD. #2	LDS	750 DIA.
RR-21.1	BISHOP GRANDIN BLVD. #4	LDS	750 DIA.
RR-22	PLAZA DR.	LDS	2400 DIA.
RR-23	RIVIERA CRES. OUTFALL	LDS	2000 DIA.
RR-24	FALCONER BAY	LDS	1200 DIA.
RR-25	MOORE AVE.	LDS	1100 DIA.
RR-26	CRANE AVE. #1	CS	600 DIA.
RR-26A	CRANE AVE. LIFT STATION	WWS	
RR-27	CRANE AVE. #2	CS	900 DIA.
RR-28	DOWKER AVE.	LDS	900 DIA.
RR-28.9	VICTORIA CRES. (NOT FOUND)	LDS	
RR-29	VICTORIA CRES. #2	LDS	750 DIA.
RR-29.5	VICTORIA CRES. (NOT FOUND)	LDS	
RR-30	LOTUS LANE	LDS	600 DIA.
RR-31	DUNKIRK DR.	LDS	1400 DIA.
RR-31A	PULBERRY ST. LIFT STATION	WWS	
RR-31.5	FERNWOOD AVE. (ABANDONED)	WWS	
RR-32	GLENVIEW AVE.	LDS	525 DIA.
RR-32.5	FERMOR AVE.	LDS	1950 DIA.
RR-33	DUNHAM RD.	LDS	1200 DIA.
RR-34	OAKCREST PL.	LDS	375 DIA.
RR-34.1	KINGSTON ROW	LDS	300 DIA.
RR-34.8	RIVERDALE AVE.	LDS	600 DIA.
RR-35	WILDWOOD GOLF COURSE	CS	900 DIA.
RR-35A	WILLOW LIFT STATION OVERFLOW	WWS	
RR-36	SOMERSET AVE.	CS	1800 DIA.
RR-36B	SOMERSET AVE. LIFT STATION	CS	
RR-37	CALROSSIE BLVD.	CS	450 DIA.
RR-37A	CALROSSIE BLVD. M.H. AT RIVERSIDE DR.	CS	
RR-38	COCKBURN ST. FPS	CS	1500 DIA.
RR-39	COCKBURN ST. LIFT STATION	CS	1800 DIA.
RR-39A	COCKBURN ST. LIFT STATION & COMM. CHAMBER	CS	
RR-39.7	ST. VITAL BRIDGE	LDS	1600 DIA.
RR-40	KINGSTON ROW UNDERPASS	LDS	750 DIA.
RR-41	CHURCHILL DR. UNDERPASS	LDS	800 DIA.
RR-42	EDINBURGH ST.	CS	800 DIA.
RR-43	KILLARNEY ST.	LDS	1200 DIA.
RR-44	MAGER DR. FPS	CS	1800 DIA.
RR-44A	MAGER LIFT STATION GRAVITY OVERFLOW	CS	
RR-45	BALTIMORE FPS	CS	1800 DIA.
RR-45A	BALTIMORE LIFT STATION GRAVITY OVERFLOW	CS	

LEGEND:

33 LAND DRAINAGE (LDS)

34 WASTEWATER OVERFLOW (WWS)

58 COMBINED SEWER OVERFLOW (CS)

98 LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE   DATE

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DRAWN BY AP	APPROVED BY
HOR. SCALE: VERTICAL:	RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998	DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

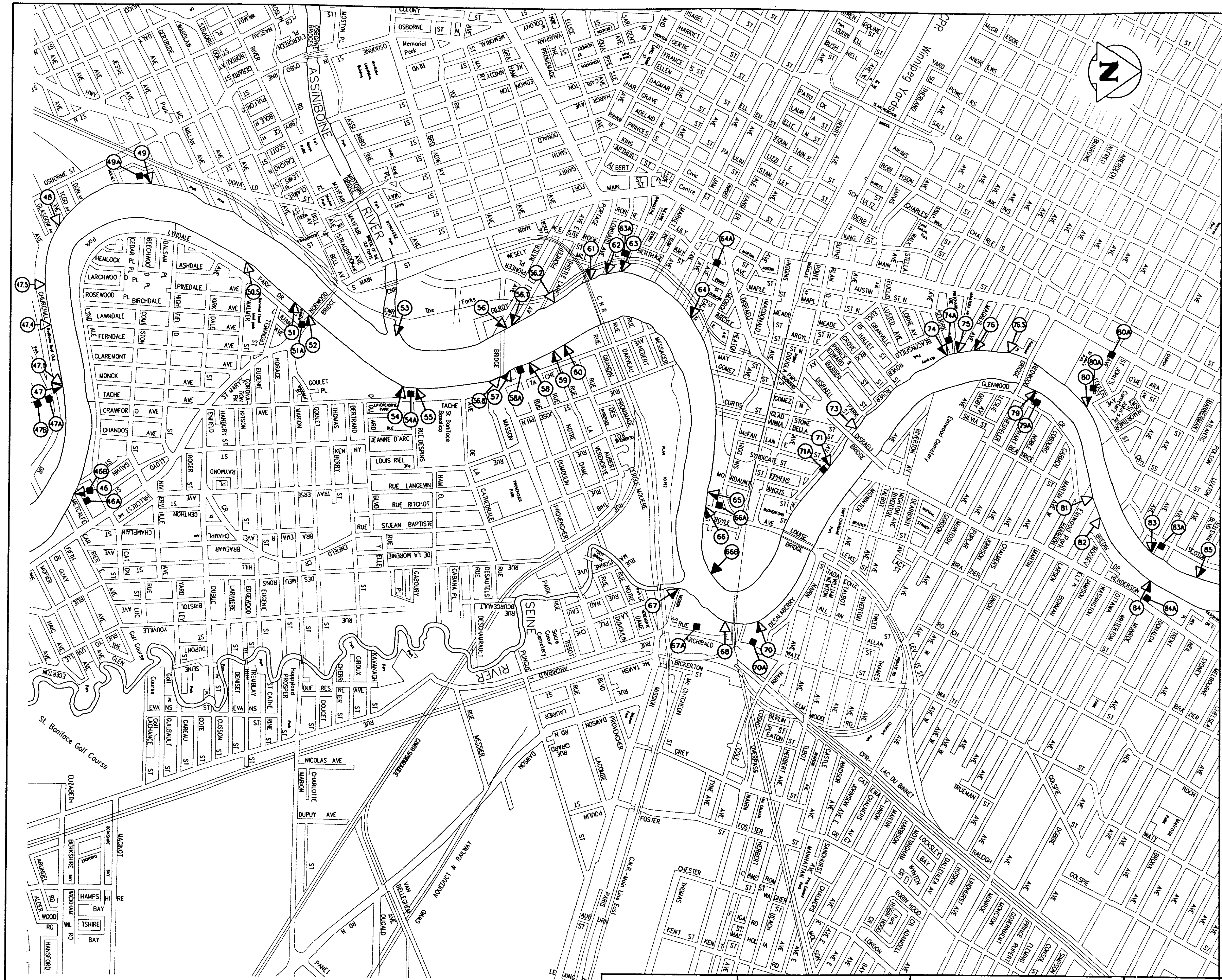
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER
BRITANNICA ROAD TO BALTIMORE ROAD

SHEET 12 OF 15

COMPUTER FILE NAME
M-562

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
RR-46	METCALFE PL.	CS	2000 DIA.
RR-46A	METCALFE PL. FPS	CS	
RR-46B	METCALFE LIFT STATION OVERFLOW	CS	
RR-47	ECCLES ST.	CS	750 DIA.
RR-47A	OVERFLOW TO LDS ON CHURCHILL DR.	CS	
RR-47B	OVERFLOW TO LDS ON ECCLES ST.	CS	
RR-47.1	ECCLES ST. AT CHURCHILL DR.	LDS	1200 DIA.
RR-47.4	OPEN CULVERT FROM FOOTBALL FIELD	LDS	300 DIA.
RR-47.5	CHURCHILL HIGH SCHOOL	LDS	1600 DIA.
RR-48	GLASGOW AVE.	LDS	1200 DIA.
RR-49	JESSIE AVE.	CS	1900 DIA.
RR-49A	JESSIE LIFT STATION, FLOOD STATION & COMM. STATION	CS	
RR-50.5	PARK DR.	CS	1200 DIA.
RR-51	MARION ST. FPD	CS	1600 DIA.
RR-51A	MARION LIFT STATION	CS	
RR-52	MARION ST. #2	CS	1800 DIA.
RR-53	ASSINIBOINE RIVER ENTERS	CS	
RR-54	RUE DESPINS	CS	1400 DIA.
RR-54A	RUE DESPINS FPS	CS	
RR-55	RUE DESPINS FPD	CS	1200 DIA.
RR-56	WATER AVE. #1	CS	450 DIA.
RR-56.1	WATER AVE. #2	CS	450 DIA.
RR-56.2	PIONEER AVE.	LDS	1400 DIA.
RR-56.8	PROVENCHER BLVD.	LDS	
RR-57	RUE DUMOULIN FPD	CS	1200 DIA.
RR-58	RUE DUMOULIN	CS	1060 DIA.
RR-58A	RUE DUMOULIN FPS	CS	
RR-59	RUE LA VERENDRYE	LDS	1200 DIA.
RR-60	RUE LA VERENDRYE FPS	CS	600 DIA.
RR-61	LOMBARD AVE.	CS	900 DIA.
RR-62	MCDERMOT AVE.	CS	2700 DIA.
RR-63	BANNATYNE AVE.	CS	1500 DIA.
RR-63A	BANNATYNE AVE. FPS	CS	
RR-64	GALT AVE. FPS	CS	1500 DIA.
RR-64A	ALEXANDER AVE. COMM. CHAMBER OVERFLOW	CS	
RR-65	BOYLE ST. FPS (ABANDONED)	CS	1050 DIA.
RR-66	BOYLE ST. (ABANDONED)	CS	900 DIA.
RR-66A	BOYLE ST. LIFT STATION OVERFLOW	ABANDONED	
* RR-66B	GATEWAY INDUSTRIES PROCESS DISCHARGE	WWS	200 DIA.
RR-67	SEINE RIVER ENTERS	CS	
RR-67A	MONTCALM LIFT STATION OVERFLOW	CS	
RR-68	ARCHIBALD UNDERPASS	LDS	750 DIA.
RR-69		ABANDONED	
RR-70	WATT ST.	CS	3700 DIA.
RR-70A	ROLAND FPS	CS	
RR-71	SYNDICATE ST. FPD	CS	1800 DIA.
RR-71A	SYNDICATE ST. – LIFT STATION	CS	
RR-73	DISRAELI BRIDGE	LDS	300 DIA.
RR-74	SELKIRK AVE.	CS	1800 DIA.
RR-74A	SELKIRK AVE. FPS	CS	
RR-75	PRITCHARD AVE.	CS	250 DIA.
RR-76	BURROWS AVE.	CS	2400 DIA.
RR-76.5	ABERDEEN AVE.	LDS	200 DIA.
RR-79	HART AVE.	CS	2850x2150
RR-79A	HART AVE. FPS–COMM. STATION	CS	
RR-80	ST. JOHN'S PARK M.H.	CS	3000 DIA.
RR-80A	ST. JOHN'S COMM. CHAMBER OVERFLOW	CS	
RR-80A	ST. JOHN'S FPS	CS	
RR-81	ELMWOOD PARK	LDS	900 DIA.
RR-82	BREDIN DR.	LDS	450 DIA.
RR-83	POLSON AVE. FPS	CS	1800 DIA.
RR-83A	POLSON AVE. COMM. CHAMBER OVERFLOW	CS	
RR-84	MUNROE AVE. FPS	CS	2500 DIA.
RR-84A	MUNROE AVE. COMM. CHAMBER OVERFLOW	CS	
RR-85	INKSTER BLVD.	CS	2900 DIA.

* – PRIVATE OUTFALL

LEGEND

- 33 LAND DRAINAGE (LDS)
- 34 WASTEWATER OVERFLOW (WWS)
- 58 COMBINED SEWER OVERFLOW (CS)
- 98 LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/C STRUCTURES COMMITTEE DATE

B.M. ELEV.

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY	CHECKED BY MD
DRAWN BY AP	APPROVED BY
HOR. SCALE: VERTICAL:	RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998	DATE

ENGINEER'S SEAL

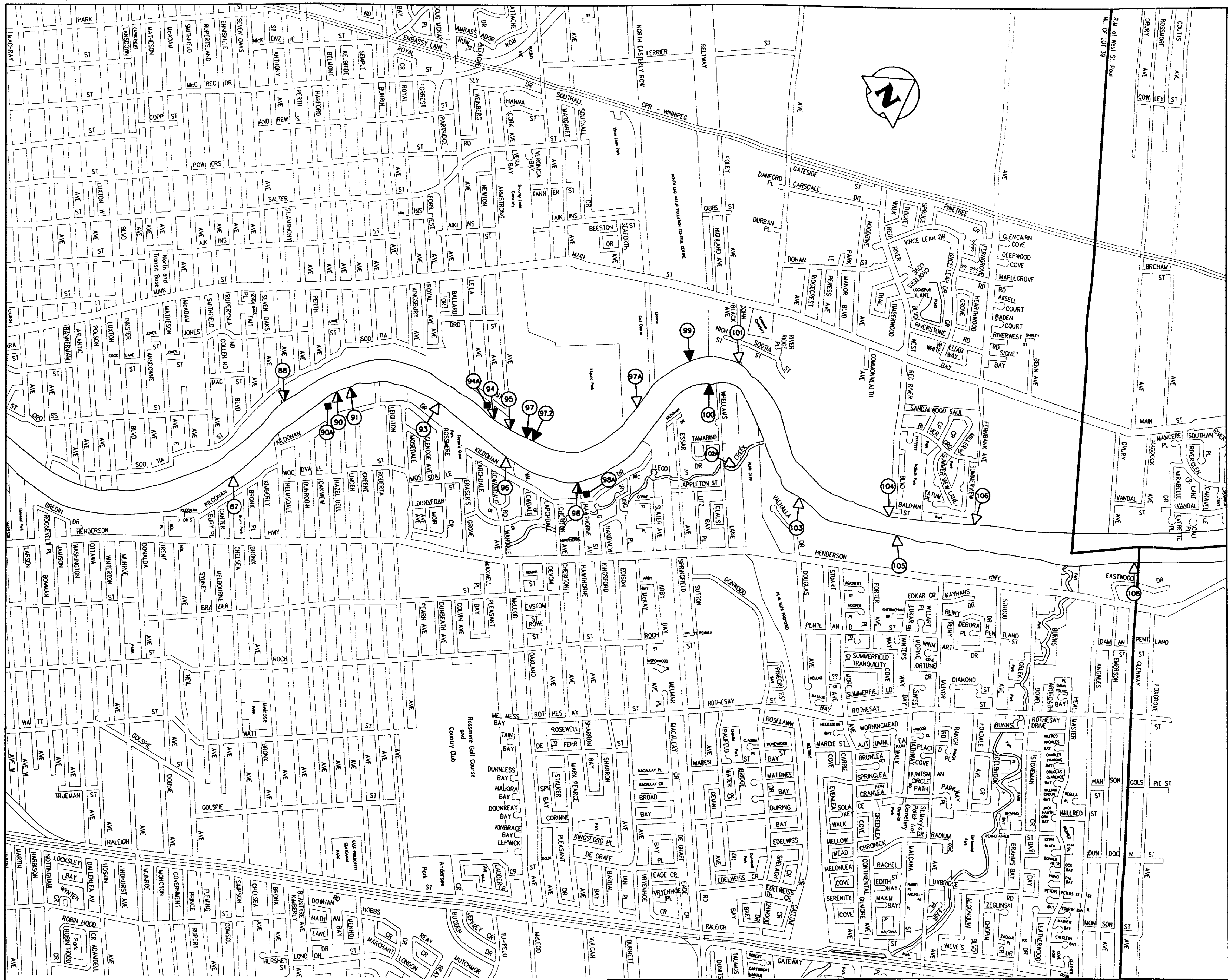
CONSULTANT DRAWING NO.
—

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER
METCALFE AVE. TO MUNROE AVE.

SHEET 13 OF 15

COMPUTER FILE NAME
M-563
CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
RR-87	CHELSEA PL.	LDS	2275 DIA.
RR-88	JEFFERSON AVE.	CS	3300 DIA.
RR-90	LINDEN AVE.	CS	1800 DIA.
RR-90A	LINDEN AVE. – LIFT STATION	CS	
RR-91	LINDEN AVE. – FPD	CS	1675 DIA.
RR-93	ROSSMERE CRES.	LDS	2900 DIA.
RR-94	NEWTON AVE.	CS	1850 DIA.
RR-94A	NEWTON AVE. – LIFT STATION	CS	
RR-95	ARMSTRONG AVE.	CS	2700 DIA.
RR-96	LARCHDALE CRES. SPS	LDS	1050 DIA.
* RR-97	KILDONAN PARK #1	LDS	250 DIA.
* RR-97A	BERLEN CUT-OFF (ABANDONED)	LDS	
RR-97.2	KILDONAN PARK #2	WWS	250 DIA.
RR-98	HAWTHORNE AVE.	CS	2200 DIA.
RR-98A	HAWTHORNE AVE. – LIFT STATION	CS	
RR-99	N.E.W.P.C.C. OUTFALL KILDONAN GOLF COURSE	TE	1200x3350
RR-100	WHELLAMS LANE	WWS	1200 DIA.
RR-101	JOHN BLACK AVE.	LDS	1800 DIA.
RR-102A	McLEOD'S CREEK	LDS	
RR-103	VALHALLA DR.	LDS	1675 DIA.
RR-104	RED RIVER BLVD.	LDS	750 DIA.
* RR-105	HENDERSON HWY. (PRIVATE)	LDS	600 DIA.
RR-106	SUMMERVIEW LANE	LDS	1800 DIA.
RR-108	EASTWOOD DR.	LDS	525 DIA.

* – PRIVATE OUTFALL

LEGEND

33 — LAND DRAINAGE (LDS)

34 — WASTEWATER OVERFLOW (WWS)

58 — COMBINED SEWER OVERFLOW (CS)

98 — LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/C STRUCTURES COMMITTEE — DATE

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B.M. ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP — CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY — CHECKED BY MD
DRAWN BY AP — APPROVED BY
HOR. SCALE: VERTICAL: — RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998 — DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER
BREDIN DR. TO PERIMETER HWY.

SHEET 14 OF 15

COMPUTER FILE NAME M-564

CITY DRAWING NUMBER

OUTFALL ID. NO.	NAME	TYPE	SIZE
FL-1	DEACON RESERVOIR	LDS	1500 DIA.
FL-2	KILDARE AT FLOODWAY	LDS	3000 DIA.

LEGEND:

(14)—▷ LAND DRAINAGE OUTFALL (LDS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/C STRUCTURES COMMITTEE — DATE

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B.M. ELEV.

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WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY	CHECKED BY MD
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HOR. SCALE: VERTICAL:	RELEASED FOR CONSTRUCTION
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ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER FLOODWAY
KILDARE AVENUE TO NAVIN ROAD

SHEET 15 OF 15
COMPUTER FILE NAME M-566
CITY DRAWING NUMBER

APPENDIX B
Rating Guidelines &
Inspection Form

APPENDIX B

RATING GUIDELINES AND INSPECTION FORM

Condition Rating Reference Report

Structural Condition Rating Guidelines

Ranking	Observed Performance Defects
1	Insignificant deformation in outfall pipe (< 2%) Evidence of dropped invert of outfall by < 2 cm Fractures in concrete pipe up to 2 mm Horizontal displacement at joint - no gap present Vertical displacement at joint - no gap present Minor evidence of ice impact; opening reduced by < 5%
2	Minor Deformation in outfall pipe (< 3%) Evidence of dropped invert of outfall by 2 - 5 cm Fractures in concrete pipe 2 -5 mm Horizontal displacement at joint with minor gap < 5 mm Vertical displacement at joint - minor gap < 5 mm Minor evidence of ice impact; opening reduced 5 - 10 %
3	Moderate Deformation in outfall pipe (< 4%) Evidence of dropped invert of outfall by 5 - 15 cm Fractures in concrete pipe 5 - 8 mm Horizontal displacement at joint with gap 5 to 15 mm Vertical displacement at joint with gap 5 to 15 mm Moderate evidence of ice impact; opening reduced 10 - 20 %
4	Significant Deformation in outfall pipe (< 5%) Evidence of dropped invert of outfall 15 - 20 cm Fractures in concrete pipe 8 - 10 mm Horizontal displacement or at joint with gap 15 to 25 mm Vertical displacement at joint with gap 15 to 25 mm Moderate evidence of ice impact; opening reduced 20 - 30 %
5	Severe Deformation in outfall pipe (> 5%) Evidence of dropped invert of outfall by >20 cm Fractures in concrete pipe > 1 cm Horizontal displacement or at joint with gap > 25 mm Vertical displacement or at joint with gap > 25 mm Severe evidence of ice impact; opening reduced > 30 %

In the above table, each RANKING category has 6 sub-conditions which would subject the Structural Rating for the outfall pipe to the particular ranking. For each ranking, the outfall pipe needs only to be categorized by one of the sub-conditions in order to be ranked. For example, an outfall pipe that has experienced a gap of 3-5 mm at a particular joint would be structurally rated a 1, provided that the condition respective to distortion, out-of-round, invert settlement, cracking or ice impacts is less severe. An outfall should be Structurally Rated on the basis of a worst case scenario. Comments entered in the comments field should describe in detail observed defects

Condition Rating Reference Report

Stream Condition Rating Guidelines

Ranking	Observed Performance Defects
1	Minor erosion - erosion between 20 and 30 metres from the outfall
2	Moderate erosion - erosion between 10 and 20 metres from the outfall
3	Significant erosion - erosion within 10 metres from the outfall
4	Severe erosion - erosion at the outfall
5	Critical erosion - structure is being undermined

Riverbank Condition Rating Guidelines

Ranking	Observed Performance Defects
1	Minimal risk of failure - only minor bank improvements required
2	Low risk of failure - stability safety factor considered to be adequate, but bank improvements will prevent long term deterioration
3	Moderate risk of failure - stability safety factor considered to be above unit under extreme conditions, but bank improvements warranted
4	High risk of failure - Stability safety factor considered to close to unity under extreme conditions (historical bank movements apparent)
5	Failure condition - active bank failures impacting on outfall, excessive distress apparent

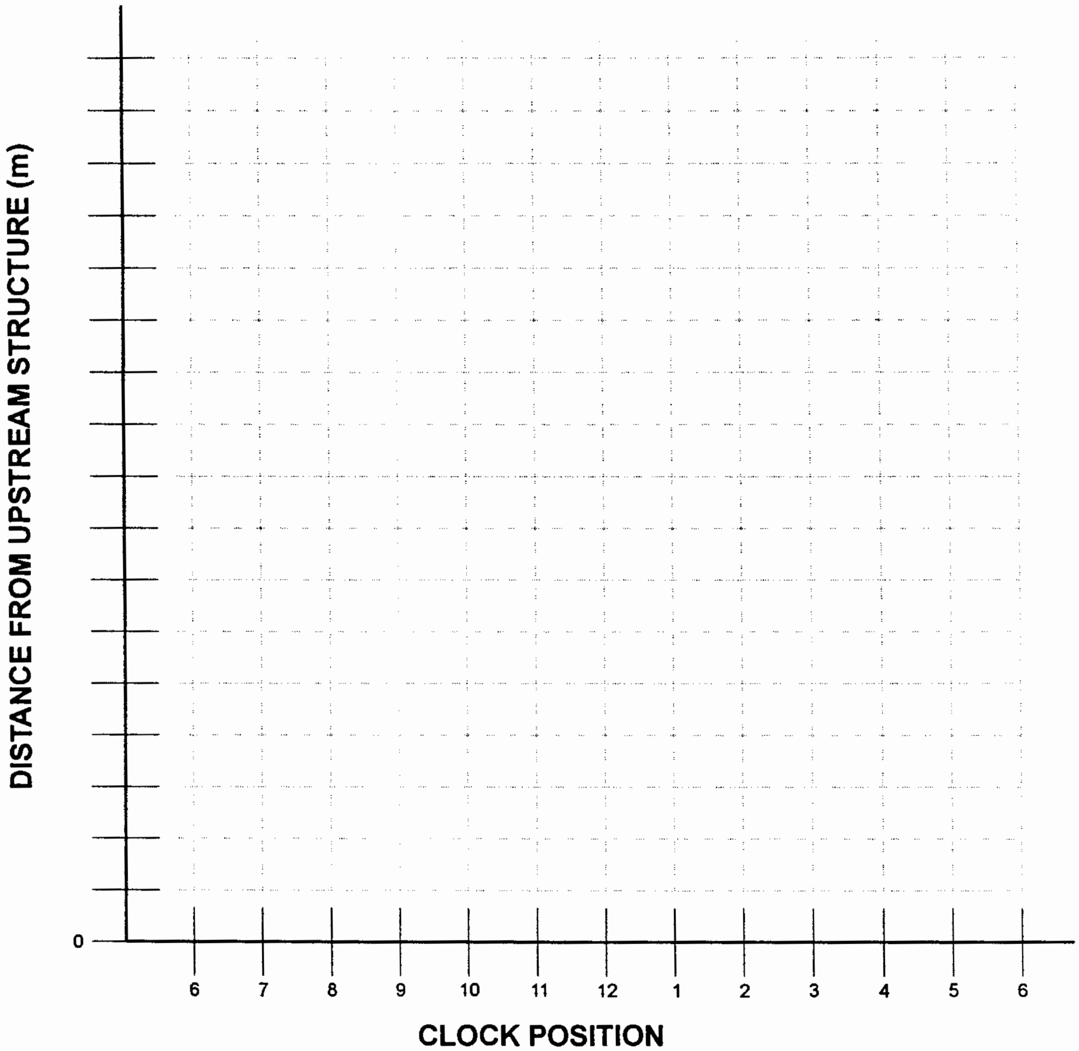
Overall Condition Rating

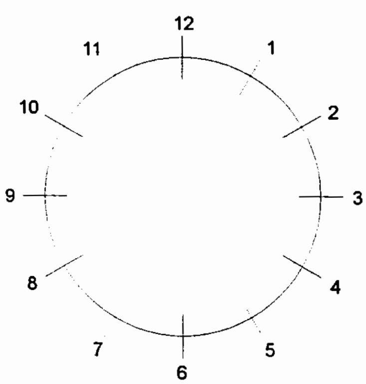
The Overall Rating for the outfall will be assessed automatically by the database. The criteria set for the Overall Rating is based on the worst case scenario. That is, if the Structural Rating is a 4, the Stream Rating is a 3, and the Riverbank Rating is a 3, then the Overall Rating will be a 4 based on the worst condition rating found during the inspection. It can be concluded that all three rating categories are considered equally important for the overall condition of the outfall.

Outfall Name: ______________ **Location:** ____________________

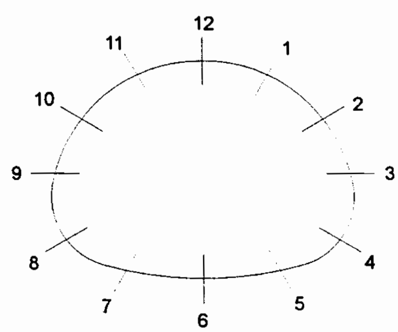
Stream: ________________ **Date:** ______________________

STRUCTURE CONDITION MAPPING CHART





Clock Reference
Looking
Downstream



Clock Reference
Looking
Downstream

LEGEND:

DEFECTIVE CONCRETE:	SPALLING	SP	**JOINTS:**	OPEN	JO
	HONEYCOMB	HC		DISPLACED	JD
	EROSION/WEAR	EW		SPALLED	SP
	DELAMINATED	DC			

HOW TO INTERPRET THE

STRUCTURE CONDITION MAPPING CHART

Definition

The structure condition mapping chart represents a detailed log of all structural anomalies inside the outfall pipe. It is used to record any noted cracks, displaced joints, pipe deformations, mis-alignments, etc.

Interpretation

The y-axis represents the position of the anomaly with respect to the closest access structure (ie., manhole, gate chamber, etc.) upstream of the outfall outlet. The zero position is defined by the access structure, and the outlet of the outfall represents the farthest distance or the greatest number on the y-axis

The x-axis represents the radial position of the anomaly with respect to its clock position inside the pipe as shown on the clock reference diagrams below the chart. In essence, the chart represents the mapping of all structural anomalies as if the pipe were to be cut longitudinally along the axis at the 6 o'clock position and laid flat.

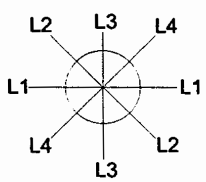
For example, a longitudinal crack exists at the 3 o'clock position 10 metres from the gate chamber, and continues at roughly the same clock position for 5 metres. If the crack thickness (gap) is 5 mm, then a solid line would be drawn on the graph from (3,10) to (3,15) and labelled **5 mm crack**.

Water and Waste Department
Outfall Condition and Maintenance Study
INSPECTION FORM[1]

Inspector:					**Date:**	
Party Members:						
Temp.	**Weather:**					
Outfall ID No:		**Location:**			**Owner:**	
Type: *LDS CS SO TS*		**Stream:**				
Segment No.	**LBIS No.**	**Shape**	**D_1 or W**	**D_2 or H**	**Length**	**Material**
1						
2						
3						

Invert of outfall (m):	**Sag depth (m):**	**Grates:** *Y N*

Deformation (mm)



	Sta.______	Sta.______	Sta._____	Sta._______
L1				
L2				
L3				
L4				

Ice Damage: *Y N*	**Description:**	
Hydraulic restrictions:	1. - *partial collapse of the pipe*	
	2. - *sediment built up in the pipe*	
	3. - *severe restriction - vegetation*	

Geotechnical Features

Bank Height	River Section	Slope	Slump	Erosion	Vegetation	Instrumentation
	Straight Outside Bend Inside Bend	1V:2H 1V:3H 1V:4H 1V:5H	Deep Seated Active Inactive Shallow Hummocky Stable Retrogressive	Toe Scour Undercutting Slope Rills	Mature Trees Scrub Brush Grass	Inclinometer Piezometer

COMMENTS OR DESCRIPTION:

Structure CR		Geotechnical CR		Stream CR	

LEGEND:

LDS	Land Drainage Sewer	Conc	Concrete Pipe
CS	Combined Sewer	CMP	Corrugated Metal Pipe
SO	Sanitary Overflow	Comp	Composite (Concrete & CMP)
TS	Treated Sewage	WS	Wood Stave Pipe

[1] For larger outfalls where significant deterioration is noted, a detailed inspection will required to document the pipe distress related to station and circumferential location.

Water and Waste Department
Outfall Condition and Maintenance Study
INSPECTION FORM[1]

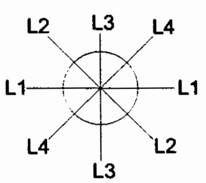
Inspector:		**Date:**
Party Members:		
Temp.	**Weather:**	

Outfall ID No:	**Location:**	**Owner:**
Type: *LDS CS SO TS*	**Stream:**	

Segment No.	LBIS No.	Shape	D_1 or W	D_2 or H	Length	Material
1						
2						
3						

Invert of outfall (m):	**Sag depth (m):**	**Grates:** *Y N*

Deformation (mm)



	Sta.______	Sta.______	Sta._____	Sta._______
L1				
L2				
L3				
L4				

Ice Damage: *Y N*	**Description:**	
Hydraulic restrictions:	1. - *partial collapse of the pipe*	
	2. - *sediment built up in the pipe*	
	3. - *severe restriction - vegetation*	

Geotechnical Features

Bank Height	River Section	Slope	Slump	Erosion	Vegetation	Instrumentation
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COMMENTS OR DESCRIPTION:

Structure CR		Geotechnical CR		Stream CR	

LEGEND:

LDS	Land Drainage Sewer	Conc	Concrete Pipe
CS	Combined Sewer	CMP	Corrugated Metal Pipe
SO	Sanitary Overflow	Comp	Composite (Concrete & CMP)
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[1] For larger outfalls where significant deterioration is noted, a detailed inspection will required to document the pipe distress related to station and circumferential location.

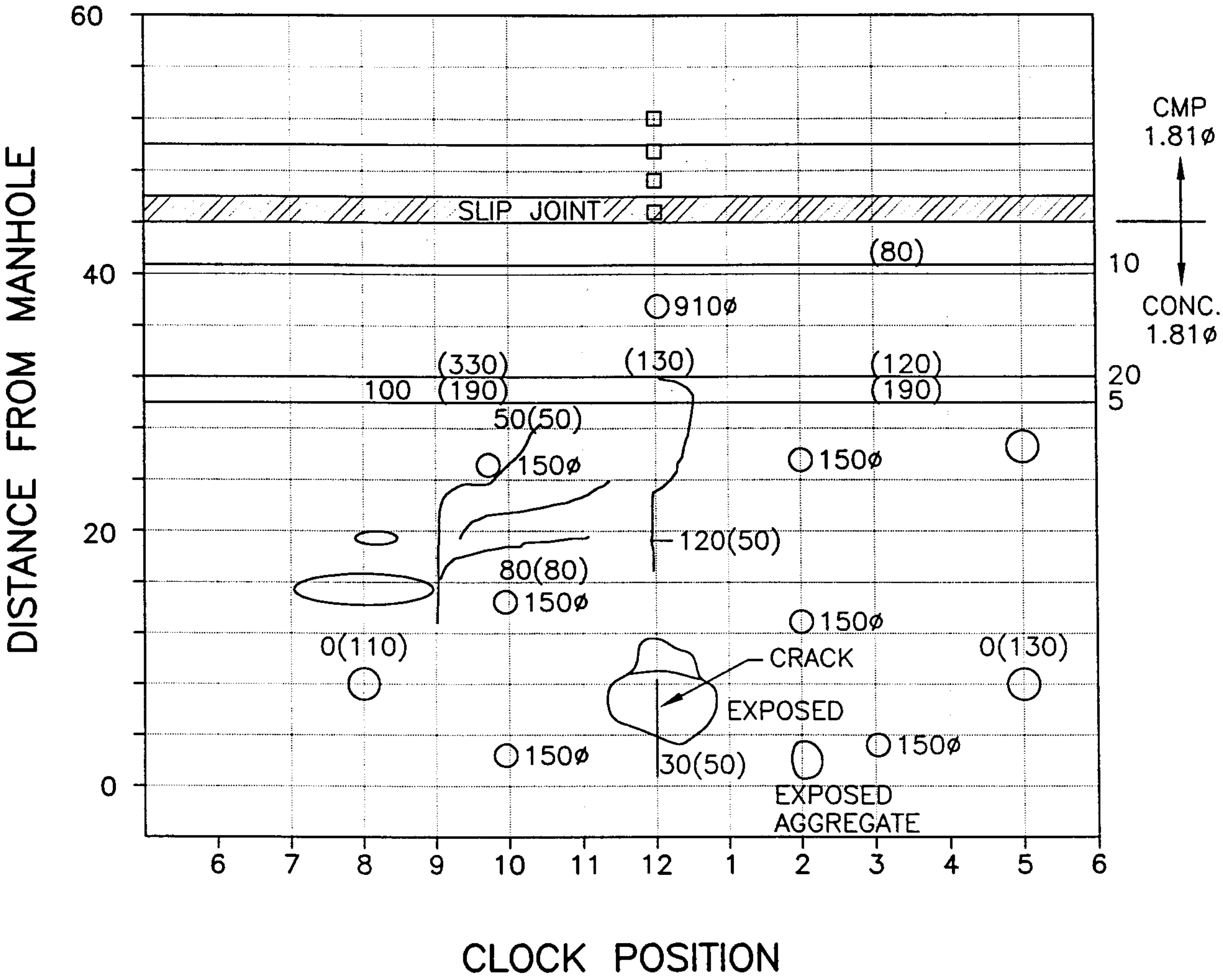
APPENDIX C
Structure Condition Charts

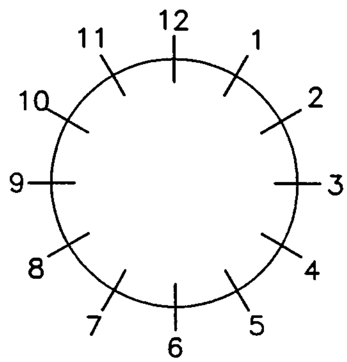
APPENDIX C

STRUCTURE CONDITION CRACK MAPPING CHARTS

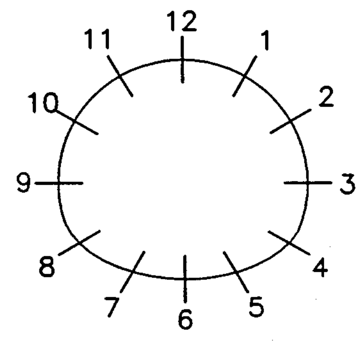
RED RIVER

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



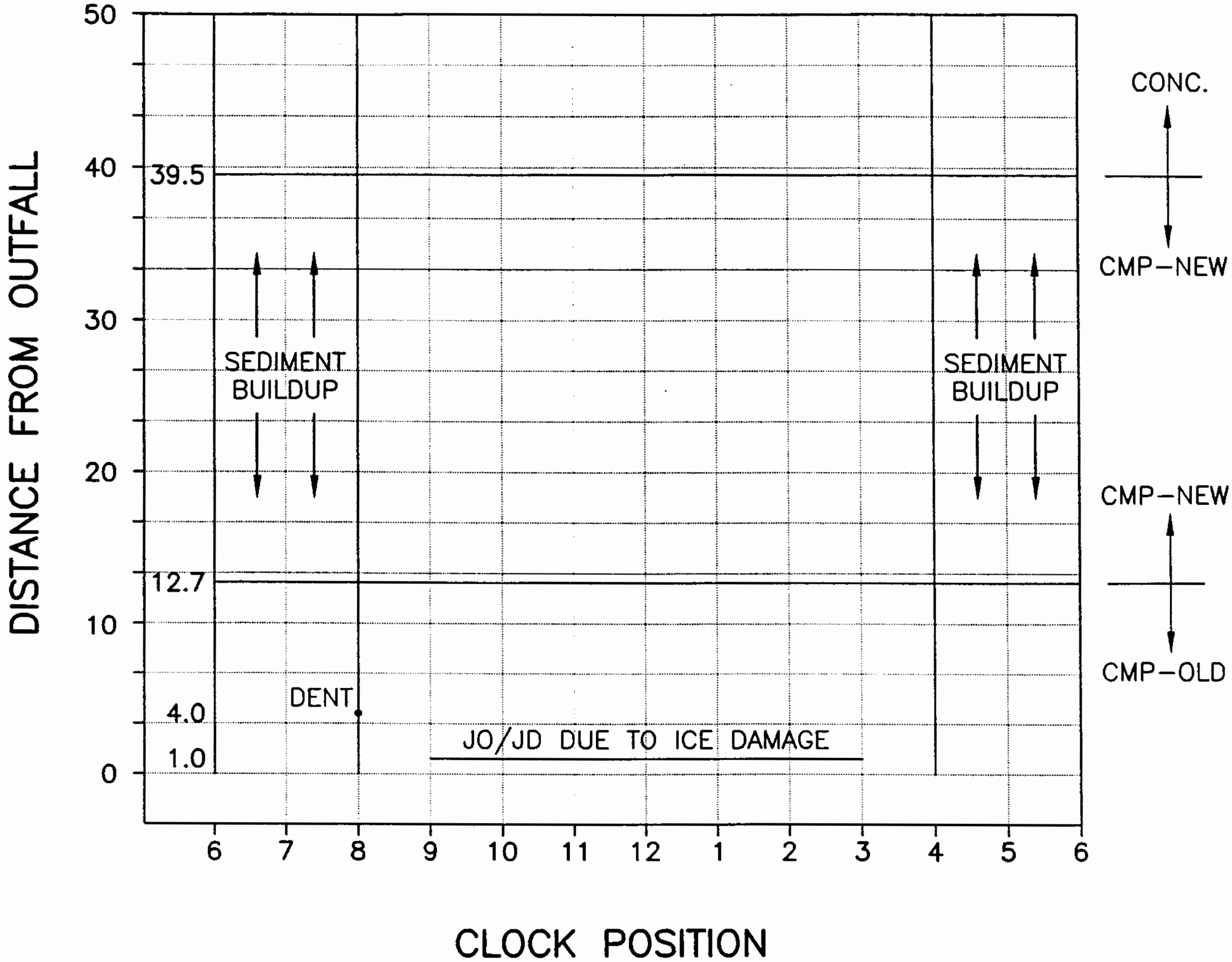
Clock Reference Looking
DOWNSTREAM

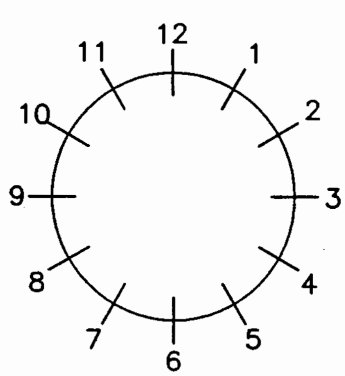
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R83	

KGS FILE NO.: 97-107-12R83

STRUCTURE CONDITION MAPPING CHART





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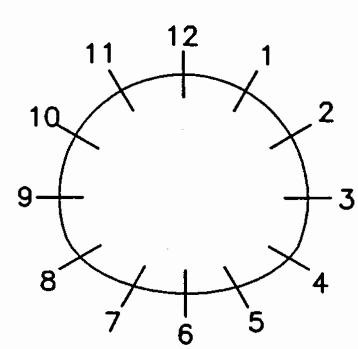
DOWNSTREAM



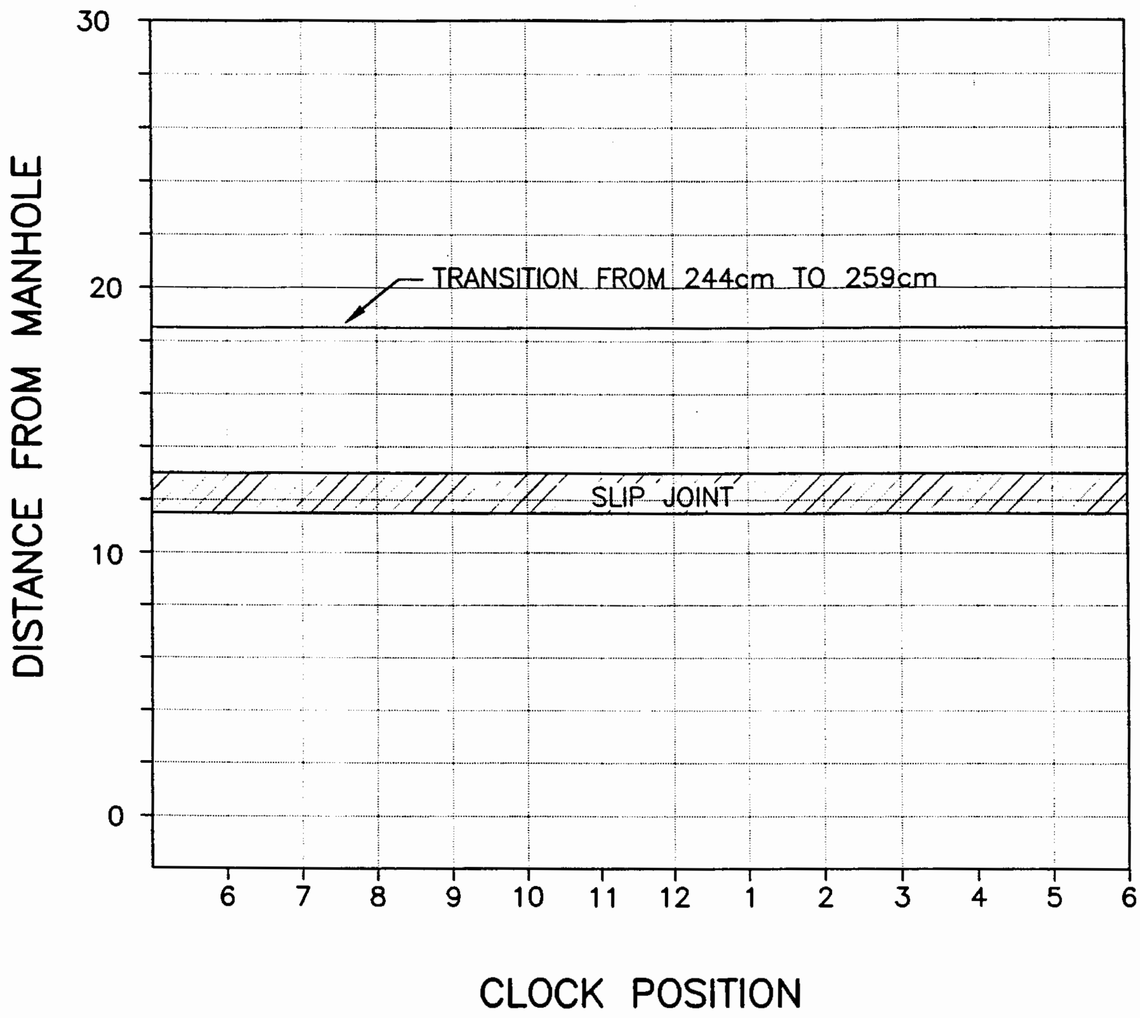
Clock Reference Looking
DOWNSTREAM

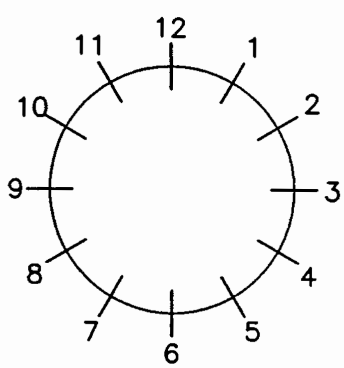
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R87	

KGS FILE NO.: 97-107-12R87

STRUCTURE CONDITION MAPPING CHART





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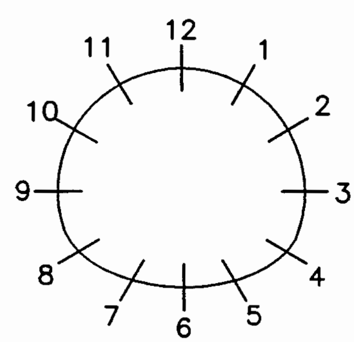
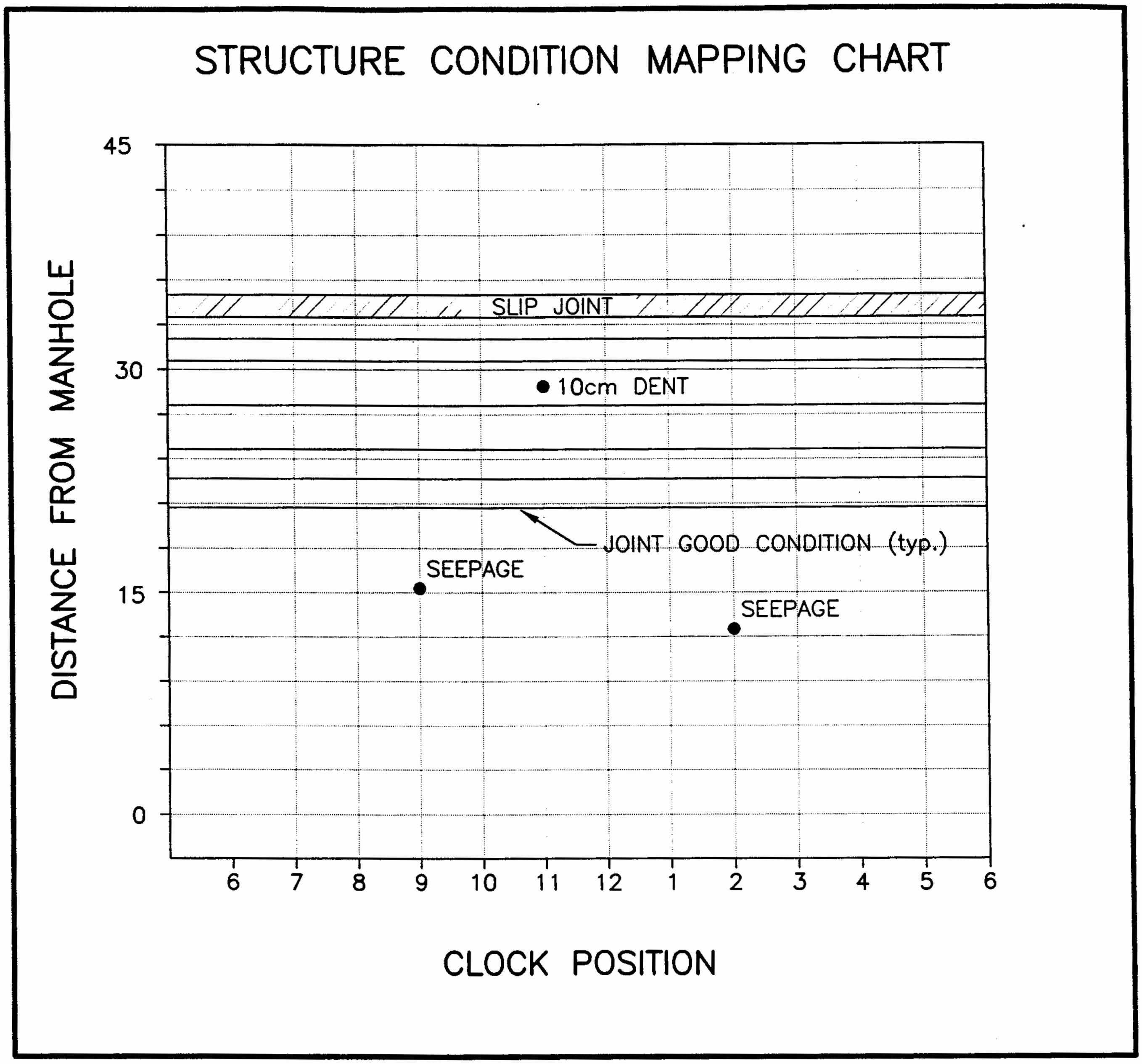


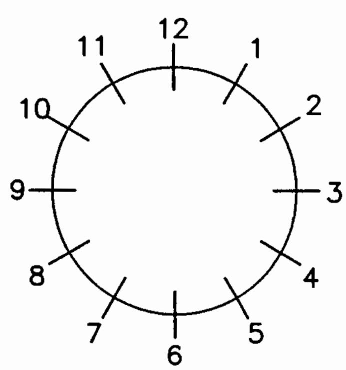
Clock Reference Looking DOWNSTREAM

LEGEND:

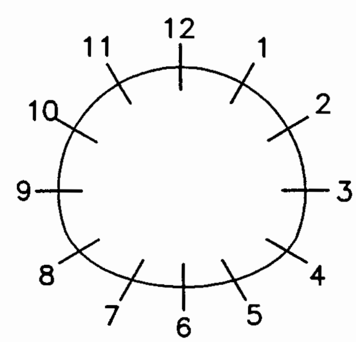
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R84	

KGS FILE NO.: 97-107-12R84





Clock Reference Looking DOWNSTREAM



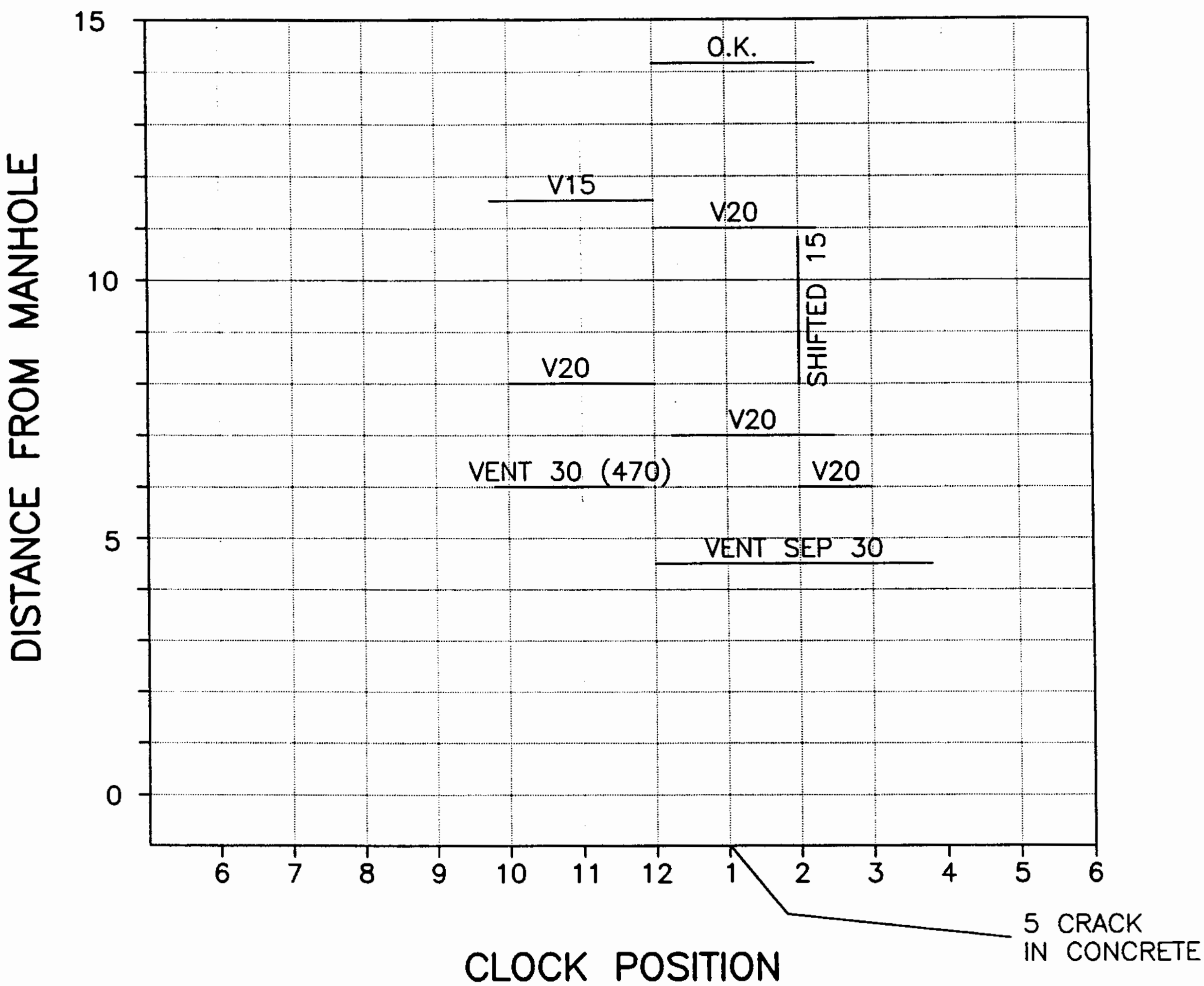
Clock Reference Looking DOWNSTREAM

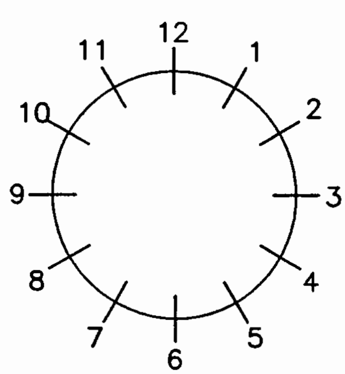
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R88	

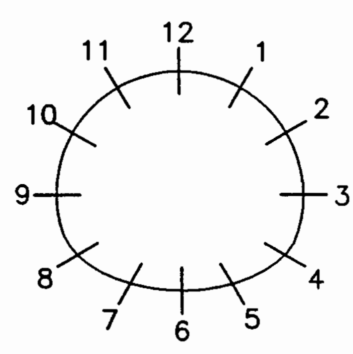
KGS FILE NO.: 97-107-12R88

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM

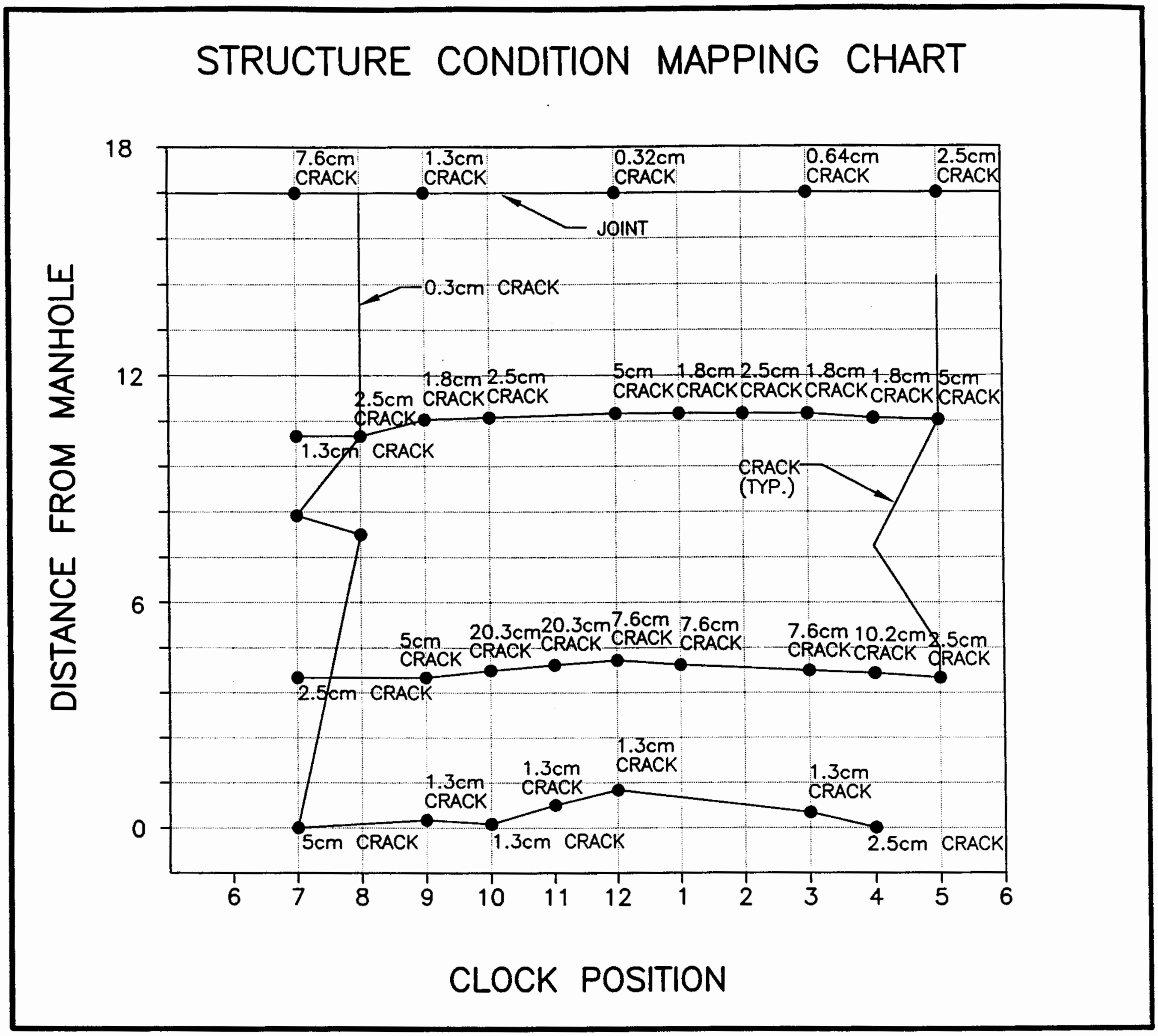


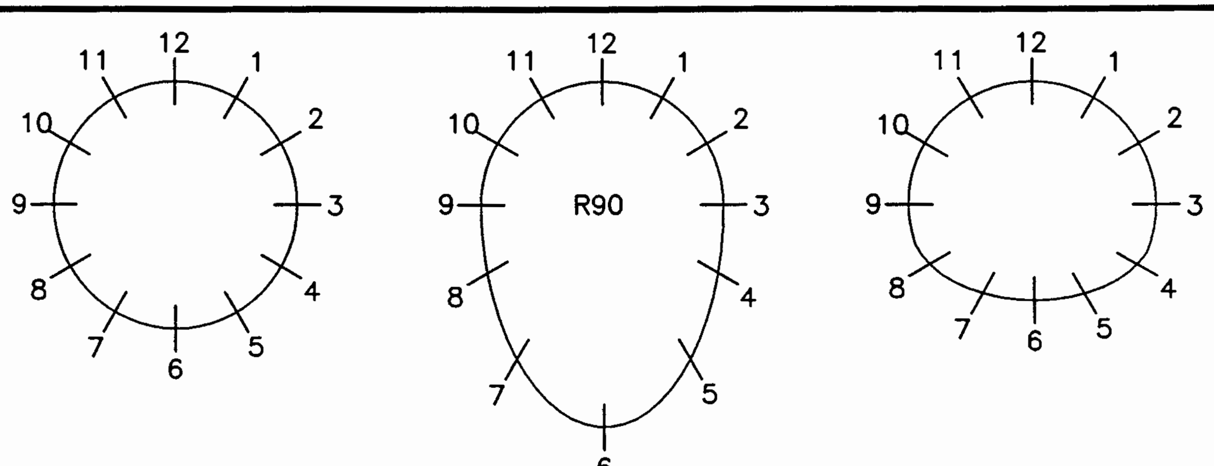
Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R88.1	

KGS FILE NO.: 97-107-12R88-1





Clock Reference Looking DOWNSTREAM | Clock Reference Looking DOWNSTREAM | Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
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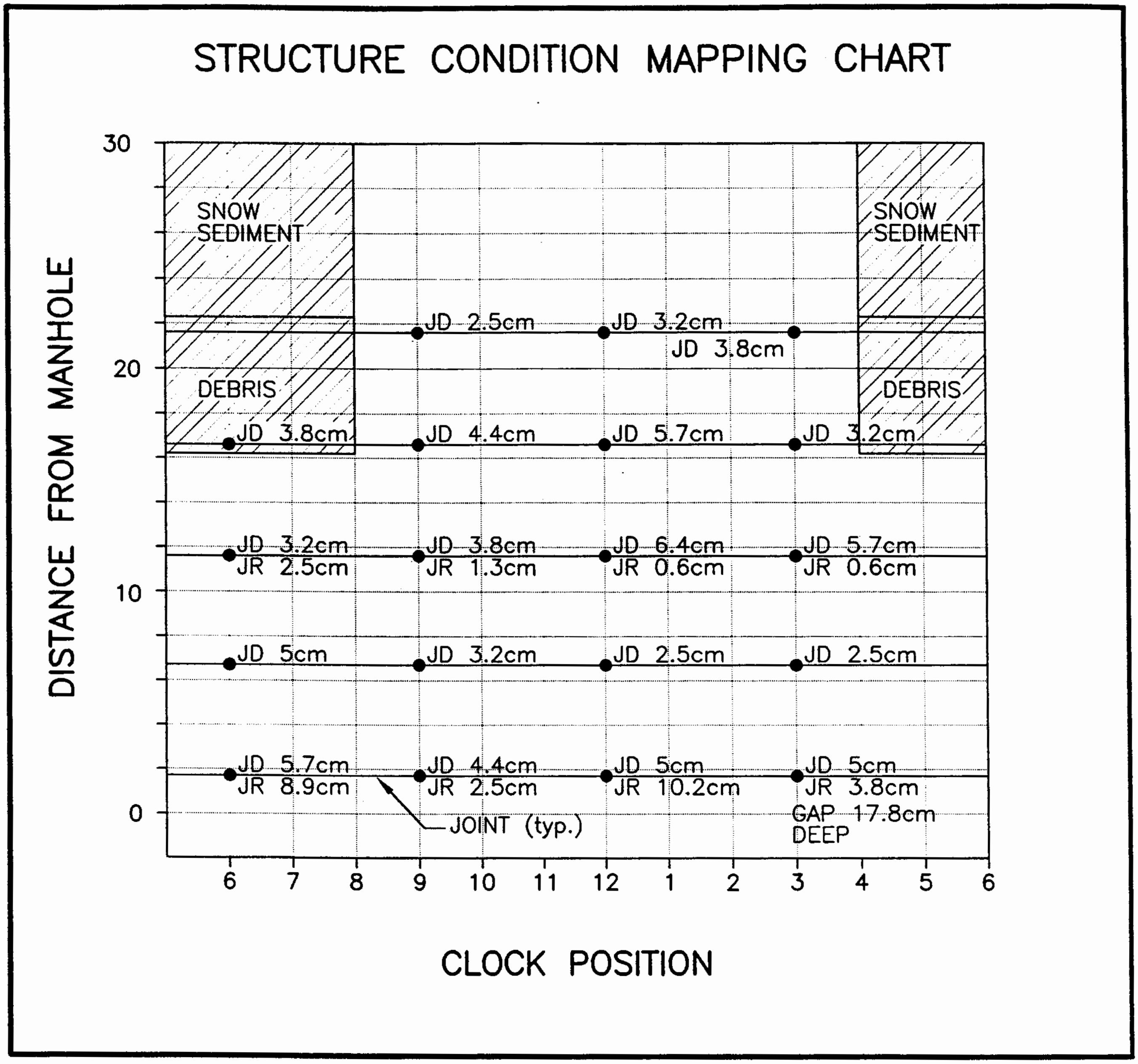
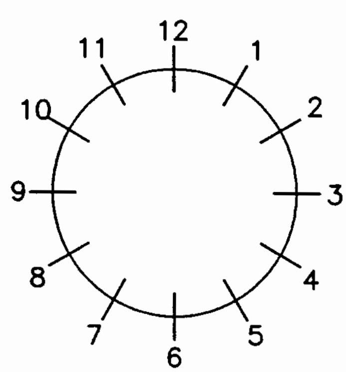
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R90	

KGS FILE NO.: 97-107-12R90





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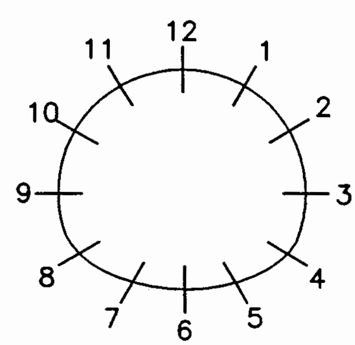

Clock Reference Looking
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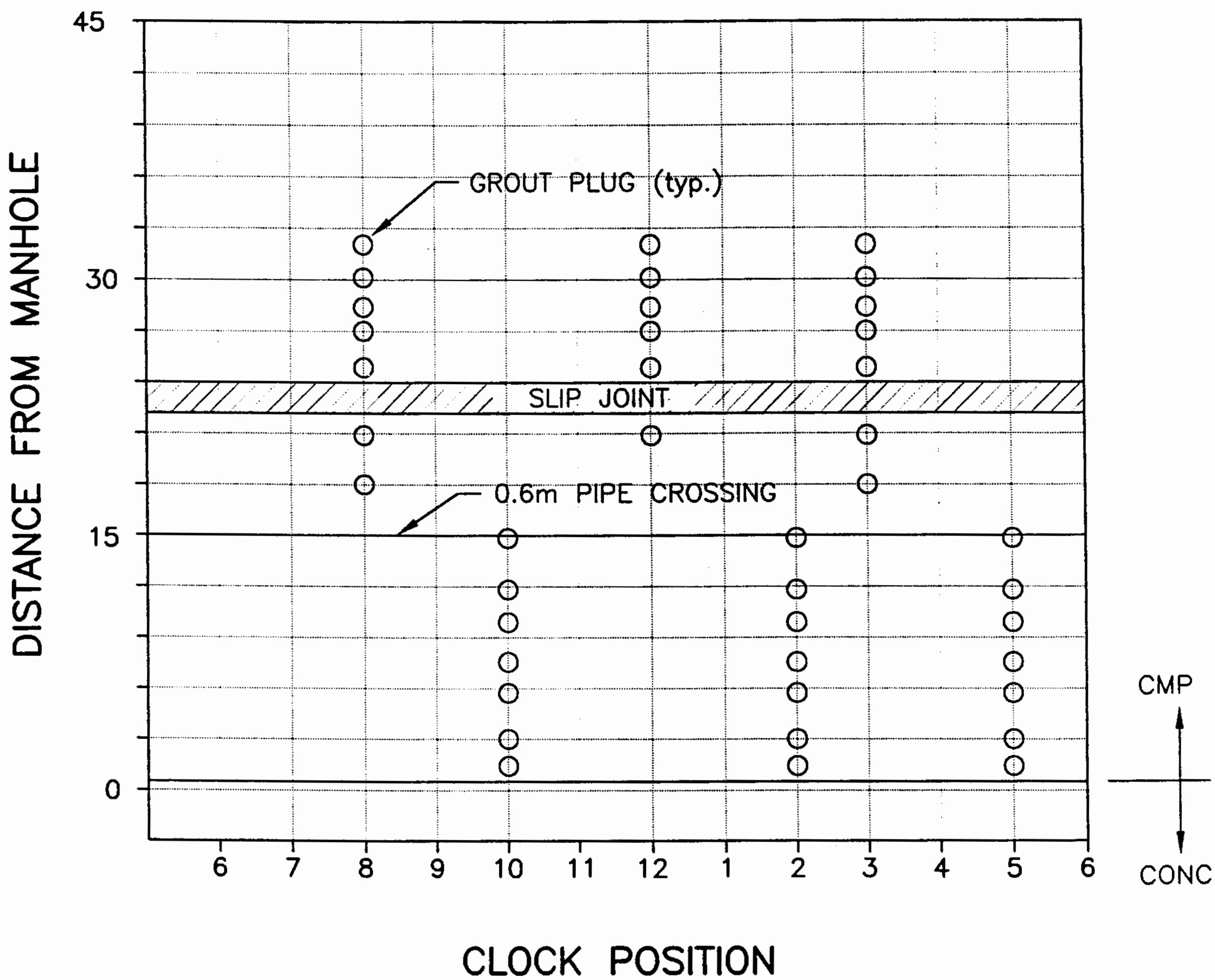
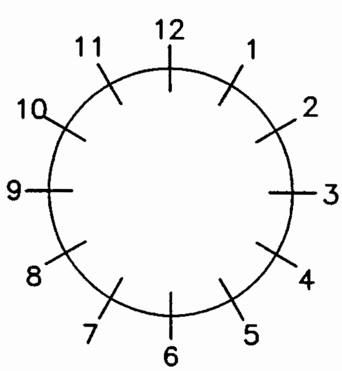
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R91	

KGS FILE NO.: 97-107-12R91

STRUCTURE CONDITION MAPPING CHART





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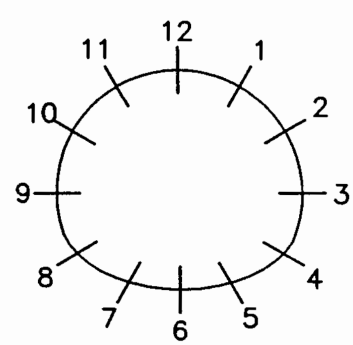


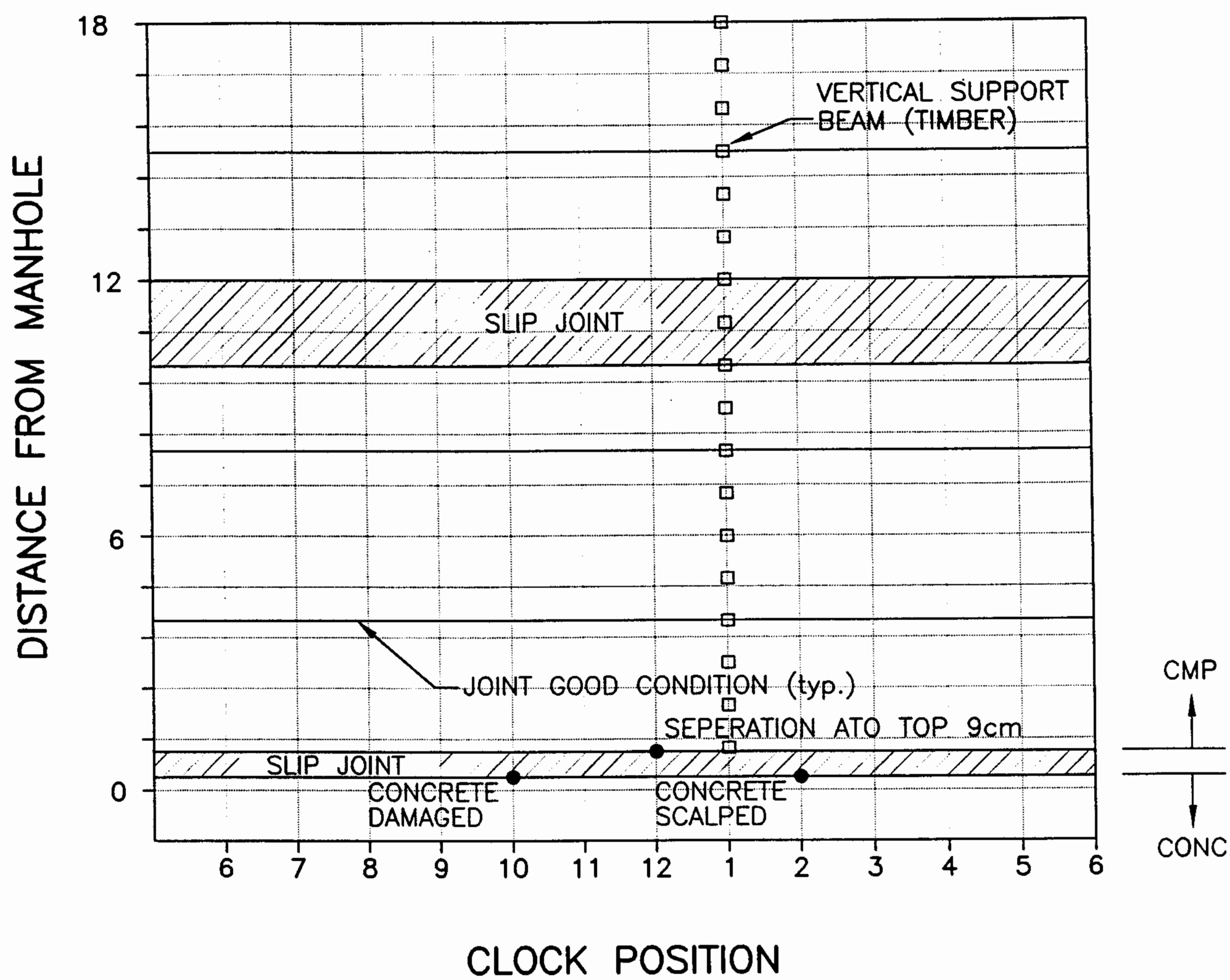
Clock Reference Looking
DOWNSTREAM

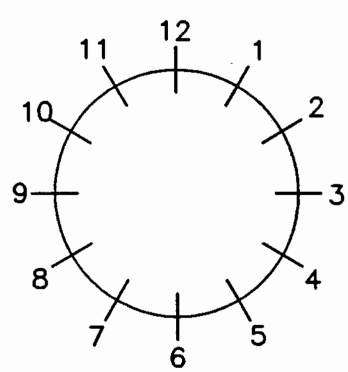
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R94	

KGS FILE NO.: 97-107-12R94

STRUCTURE CONDITION MAPPING CHART





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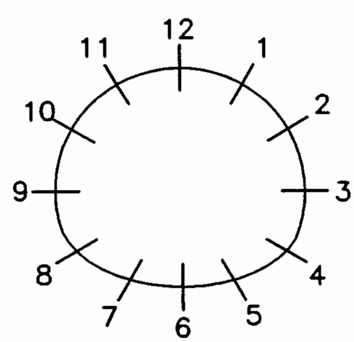


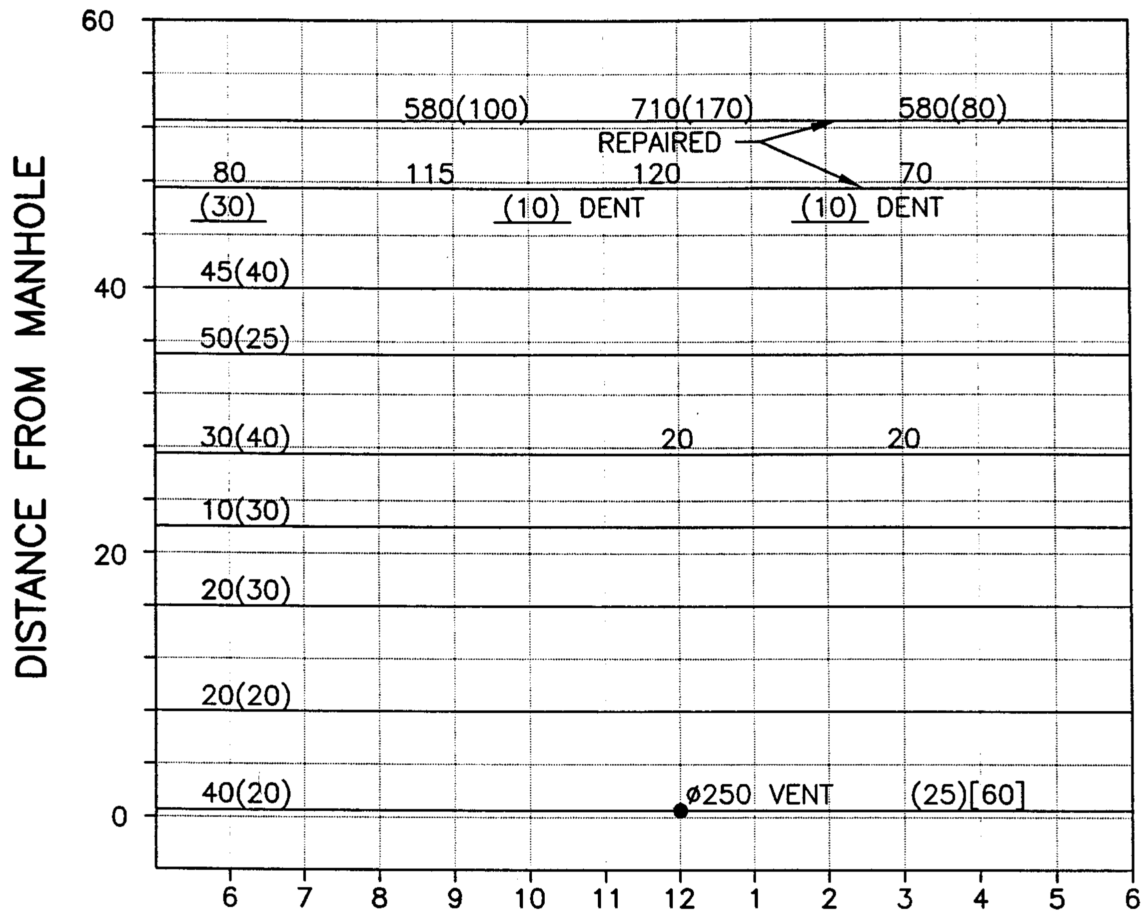
Clock Reference Looking DOWNSTREAM

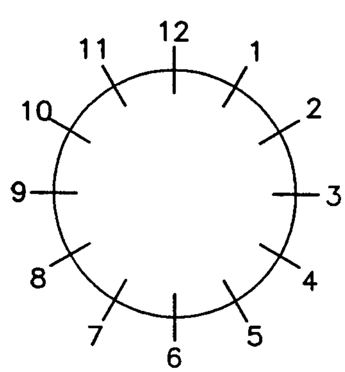
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R95	

KGS FILE NO.: 97-107-12R95

STRUCTURE CONDITION MAPPING CHART





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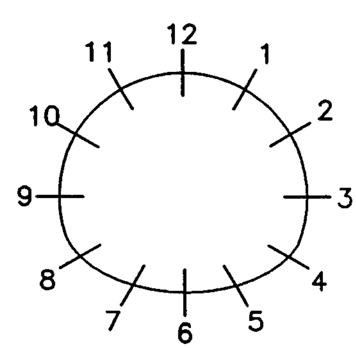
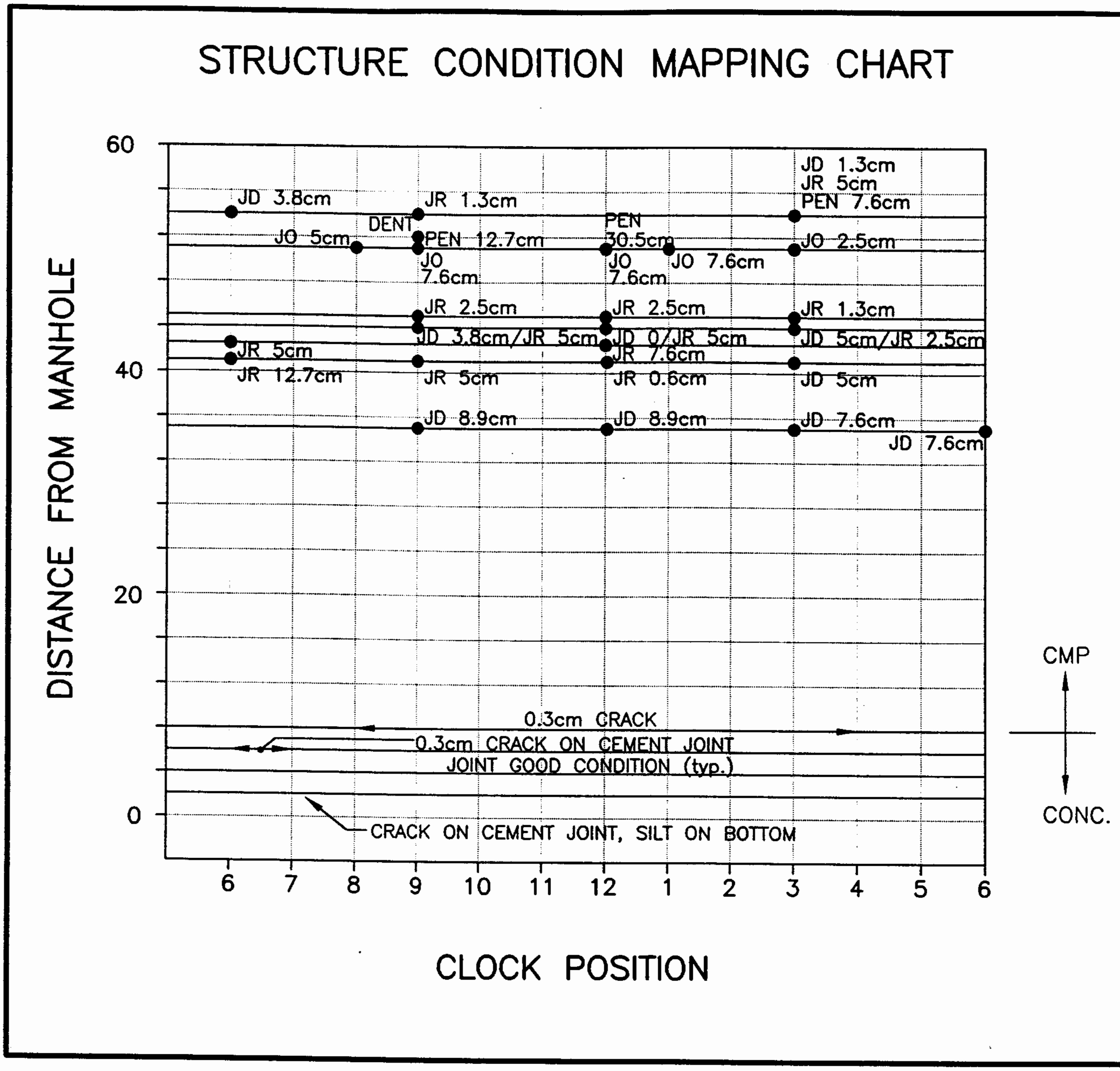


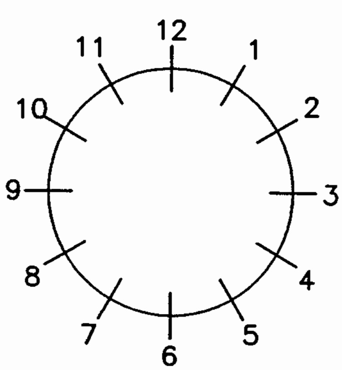
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R98	

KGS FILE NO.: 97-107-12R98





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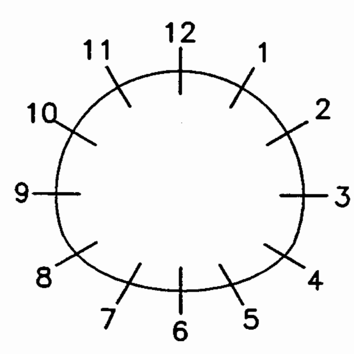


Clock Reference Looking
DOWNSTREAM

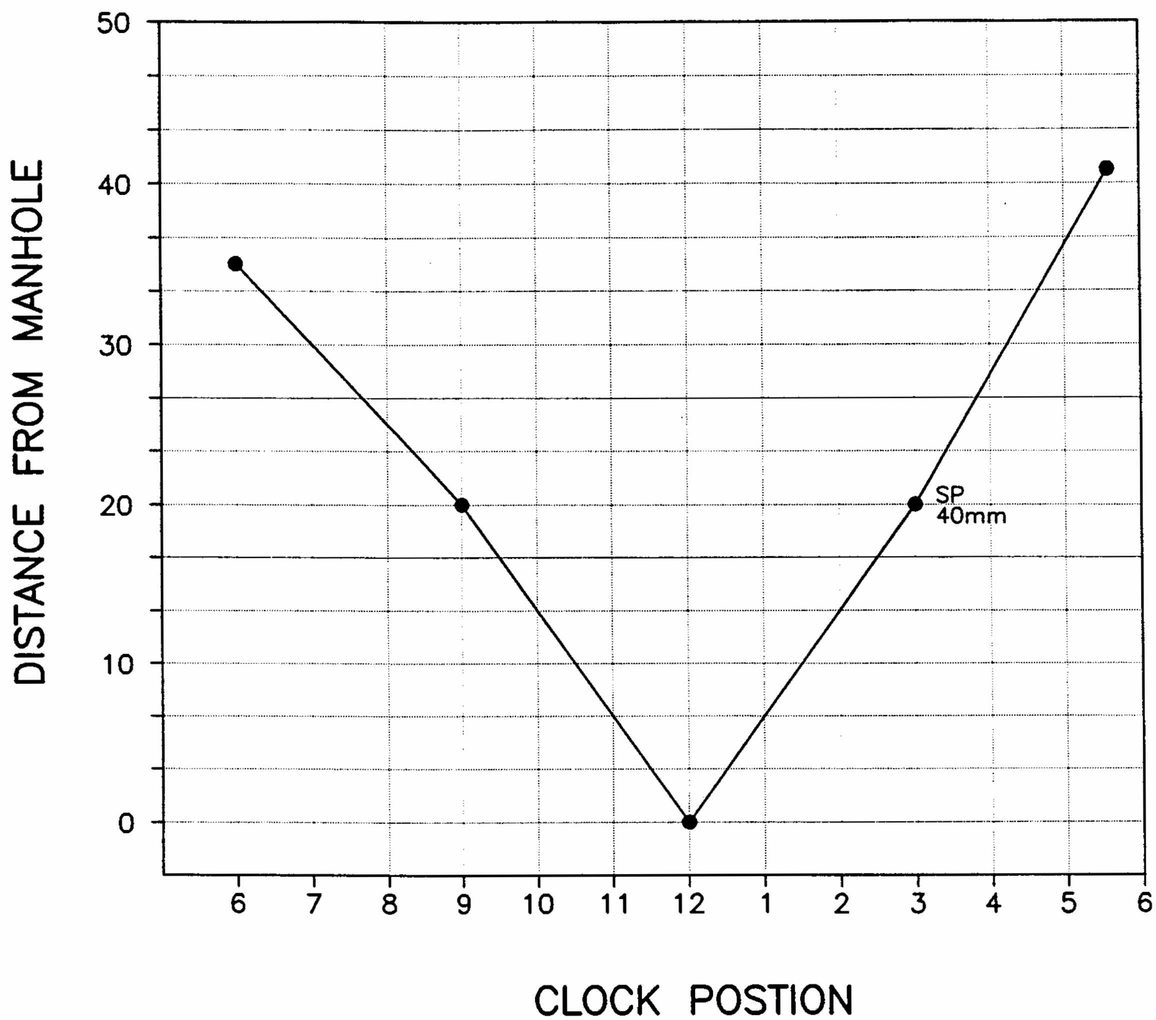
LEGEND:

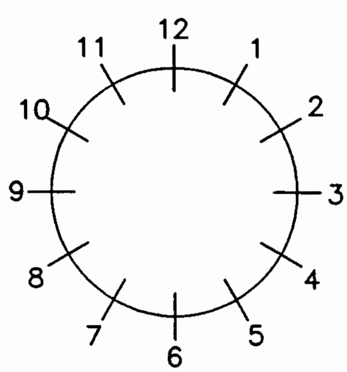
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R103	

KGS FILE NO.: 97-107-12R103

ASSINIBOINE RIVER

STRUCTURE CONDITION MAPPING CHART





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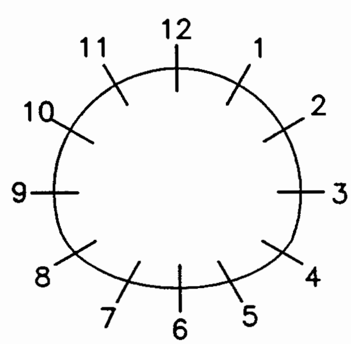


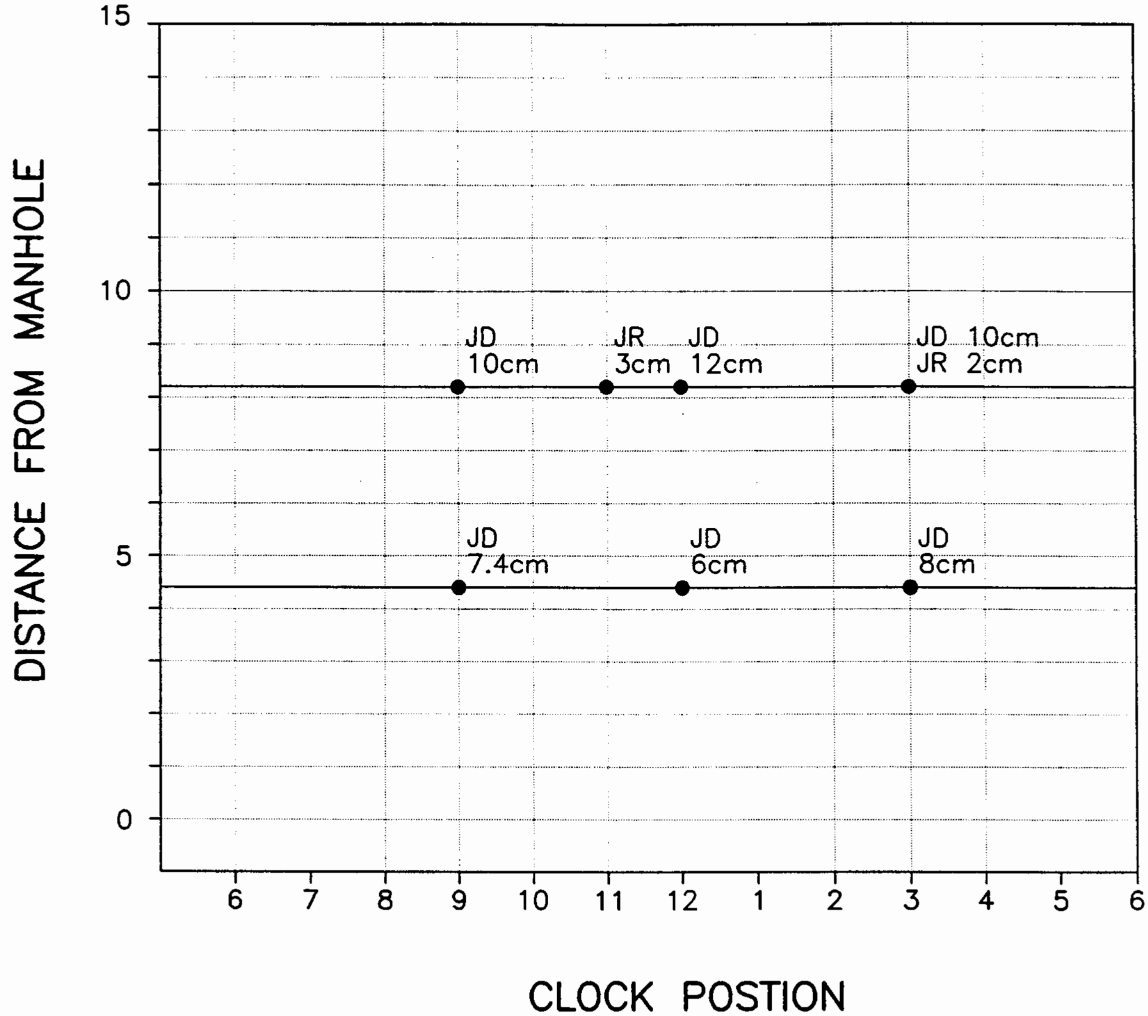
Clock Reference Looking
DOWNSTREAM

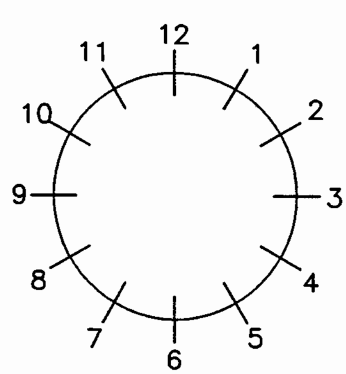
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A1	

KGS FILE NO.: 97-107-12A1

STRUCTURE CONDITION MAPPING CHART





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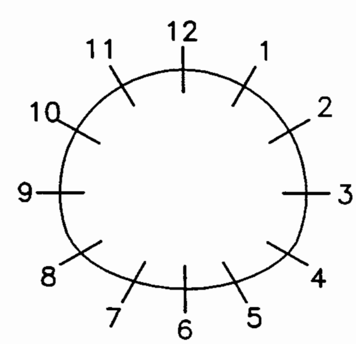


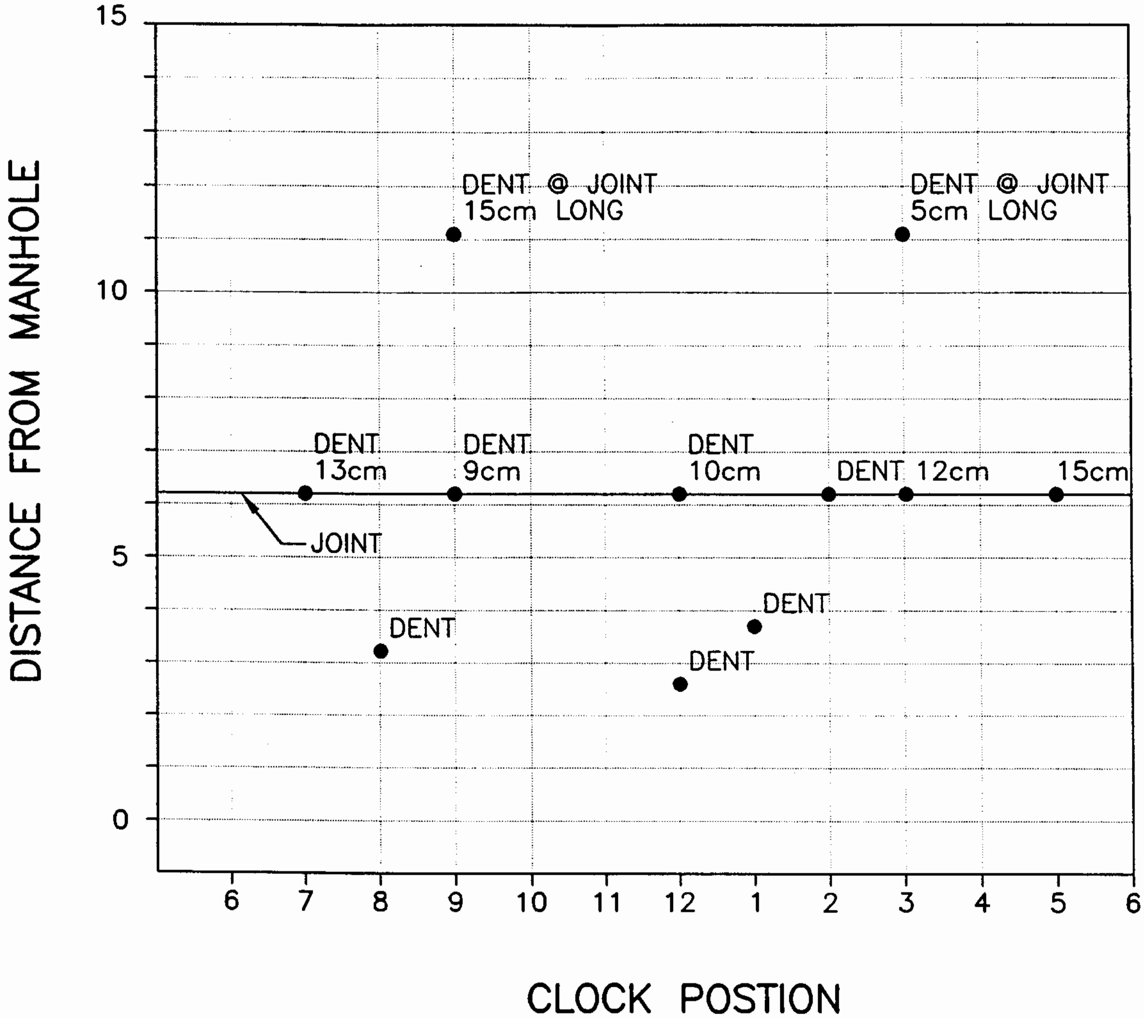
Clock Reference Looking DOWNSTREAM

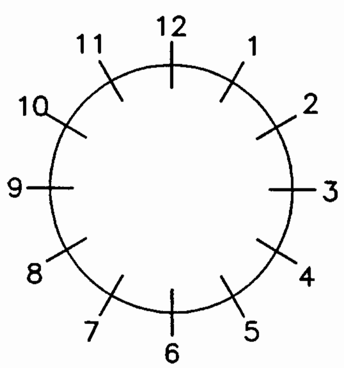
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A2	

KGS FILE NO.: 97-107-12A2

STRUCTURE CONDITION MAPPING CHART





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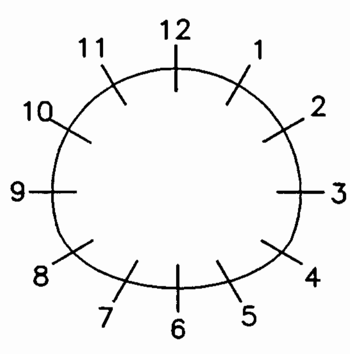


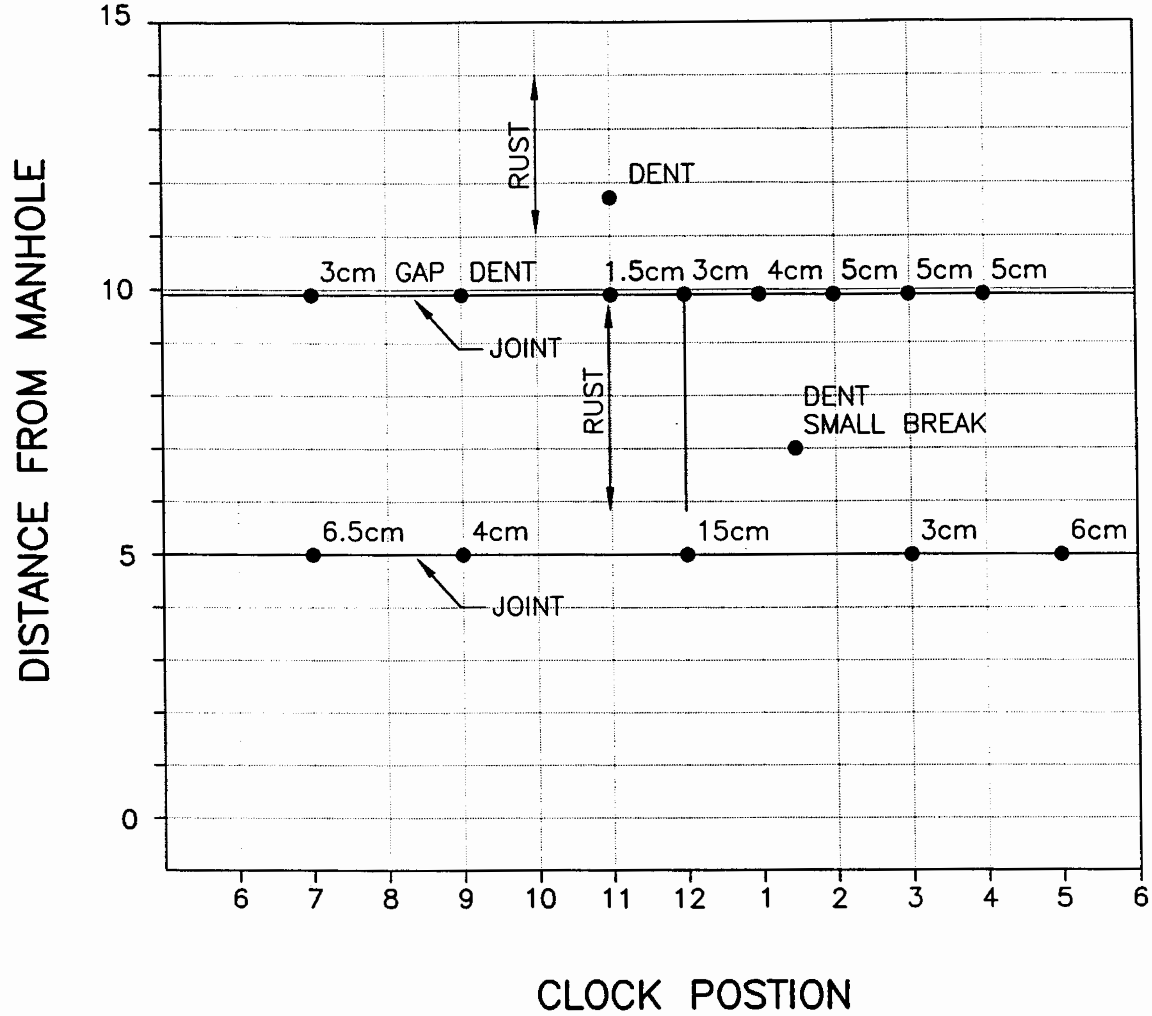
Clock Reference Looking
DOWNSTREAM

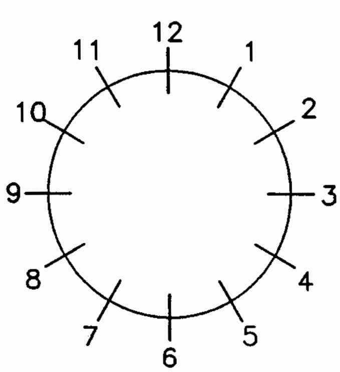
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	$A3_1$	

KGS FILE NO.: 97-107-12A3-1

STRUCTURE CONDITION MAPPING CHART





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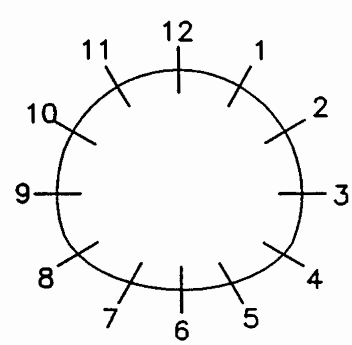


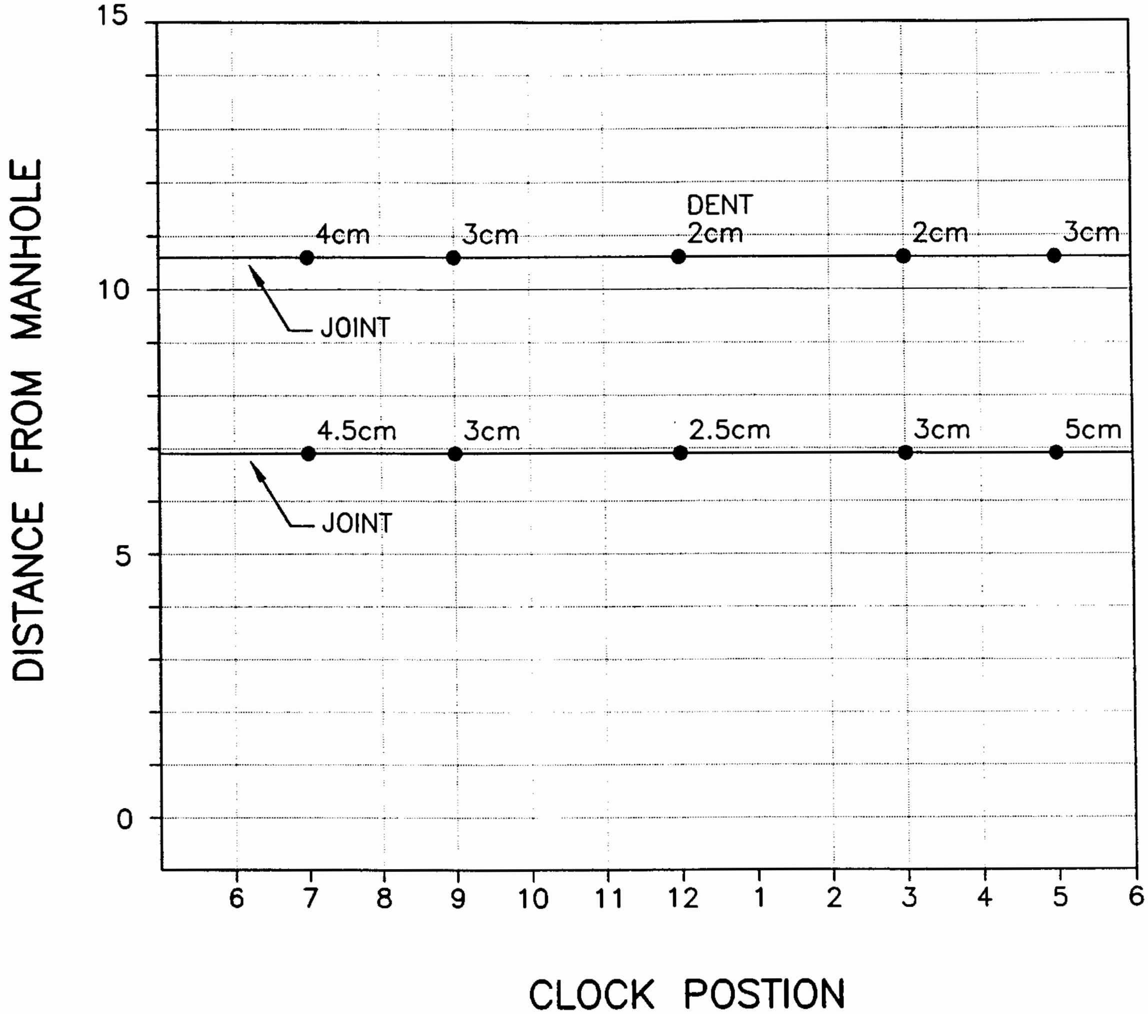
Clock Reference Looking
DOWNSTREAM

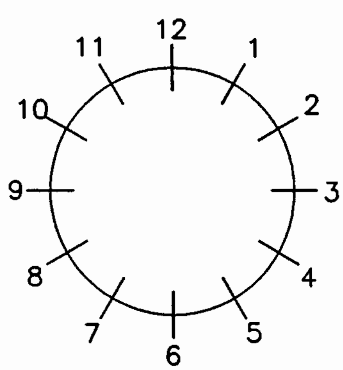
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	$A3_2$	

KGS FILE NO.: 97-107-120A3-2

STRUCTURE CONDITION MAPPING CHART





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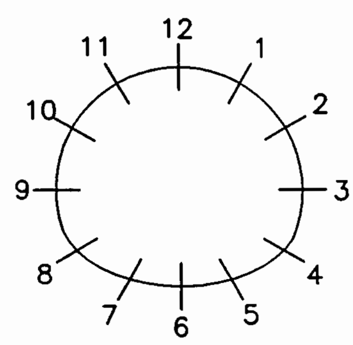

Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
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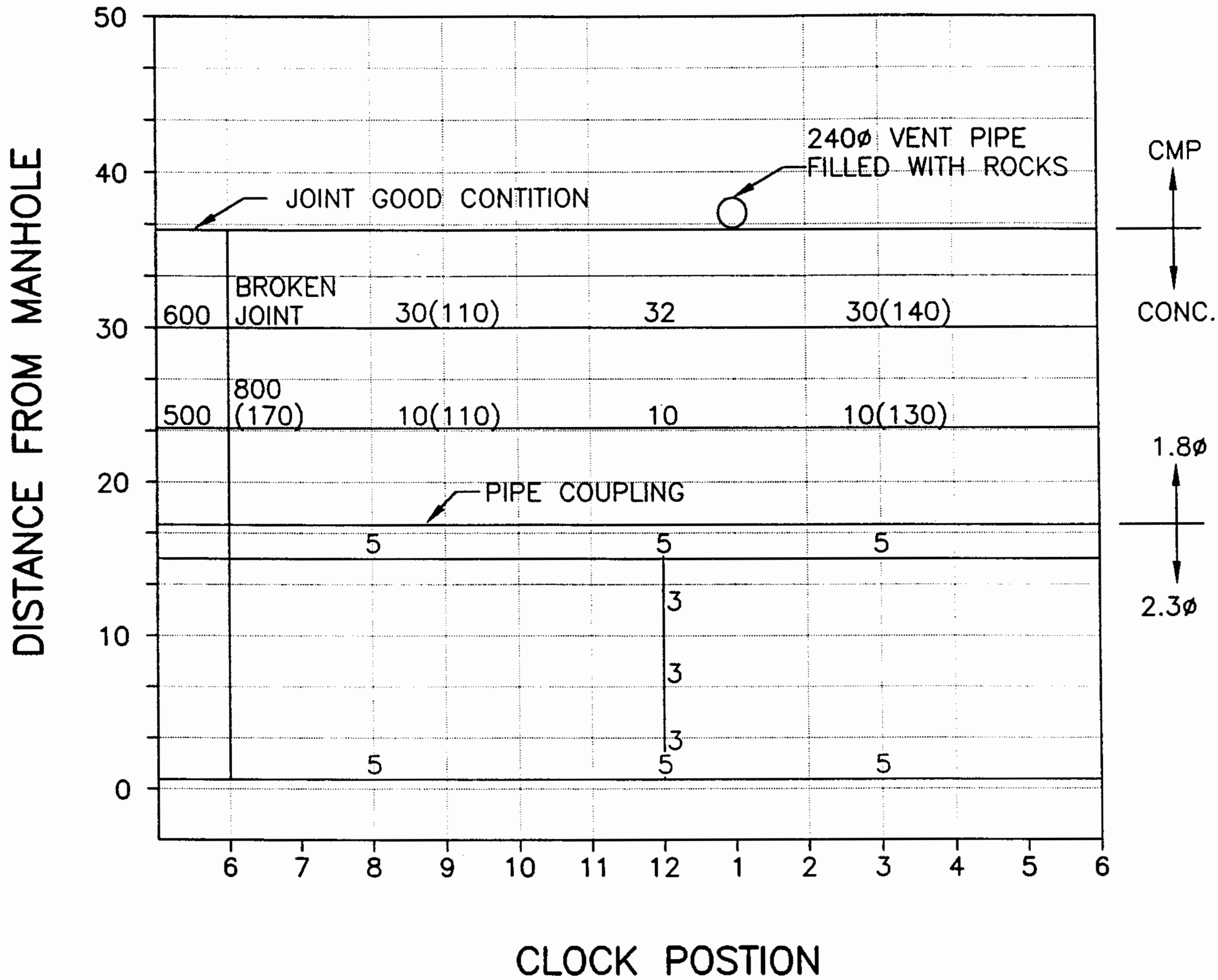
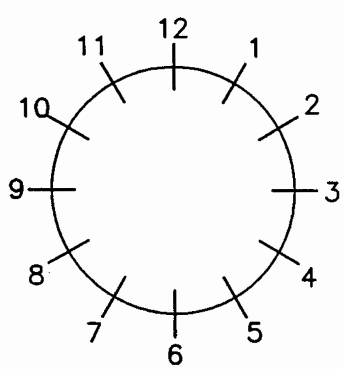
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	$A5_1$	

KGS FILE NO.: 97-107-120A5-1

STRUCTURE CONDITION MAPPING CHART





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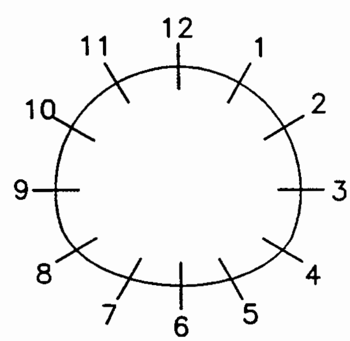

Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
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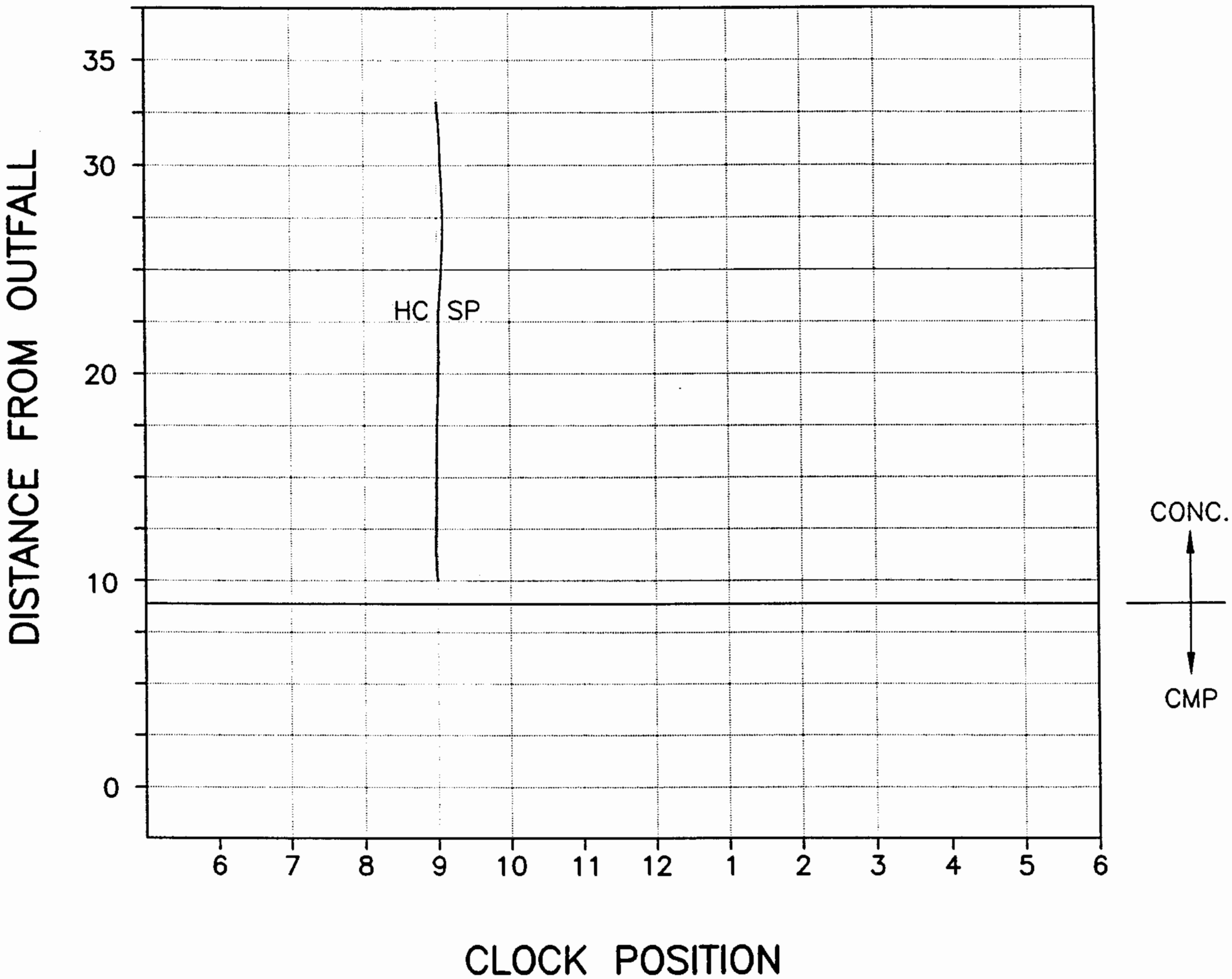
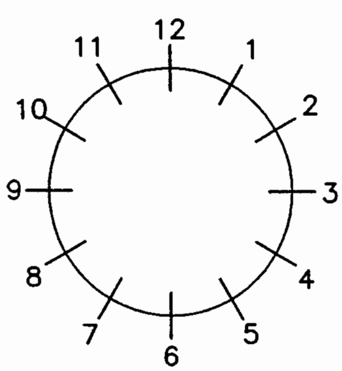
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A10	

KGS FILE NO.: 97-107-12A10

STRUCTURE CONDITION MAPPING CHART





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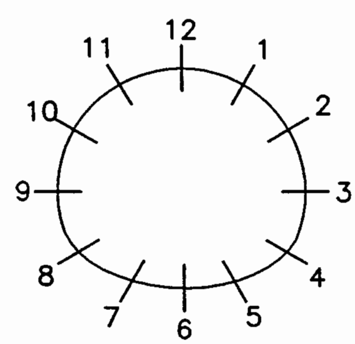


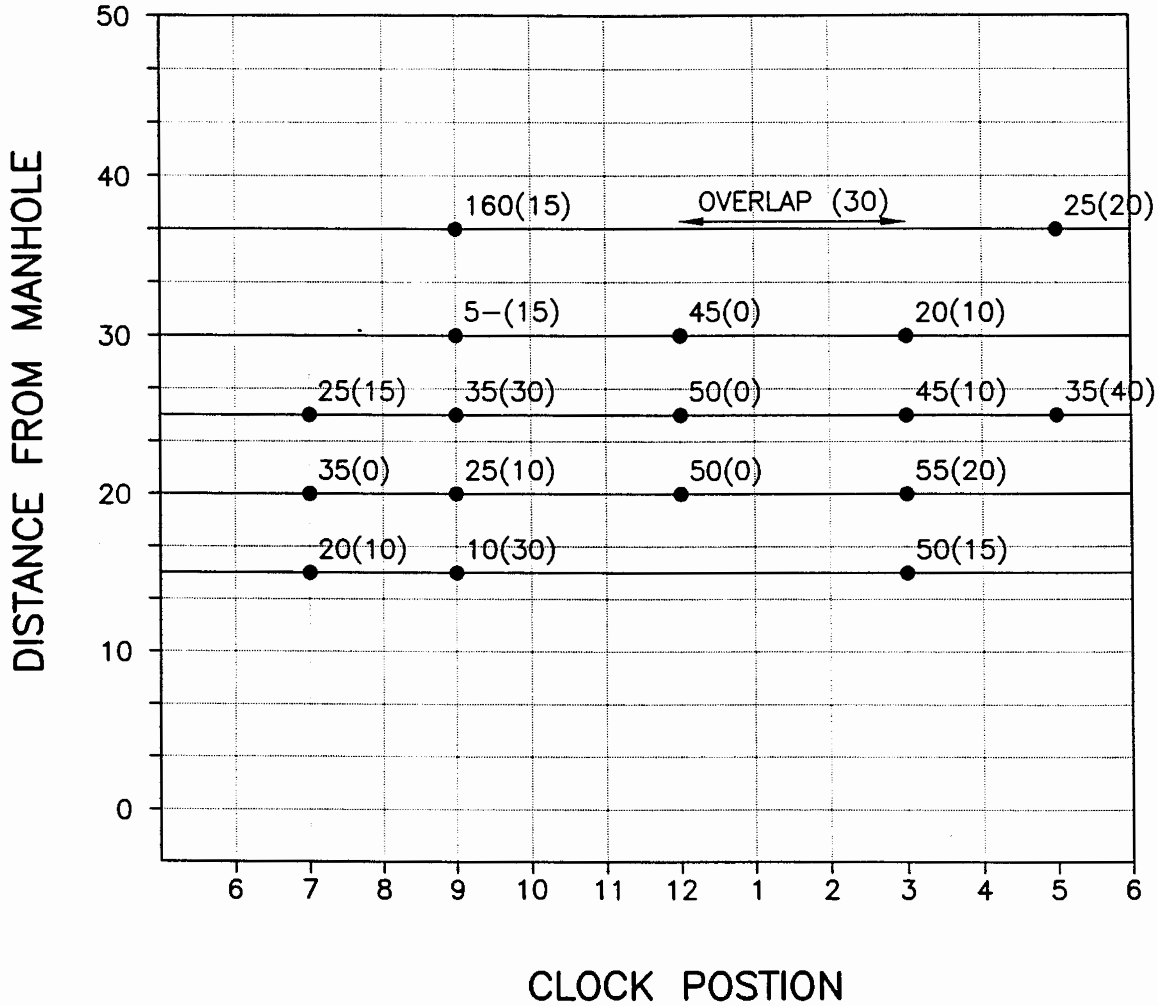
Clock Reference Looking
DOWNSTREAM

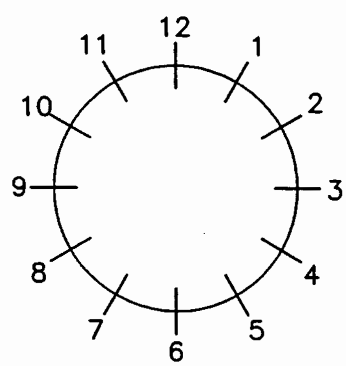
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A16.1	

KGS FILE NO.: 97-107-12A16-1

STRUCTURE CONDITION MAPPING CHART





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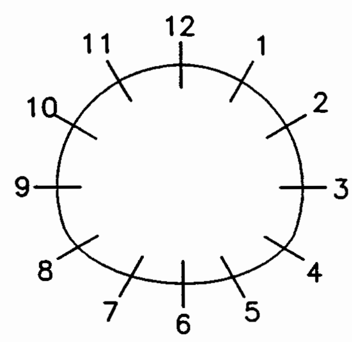

Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
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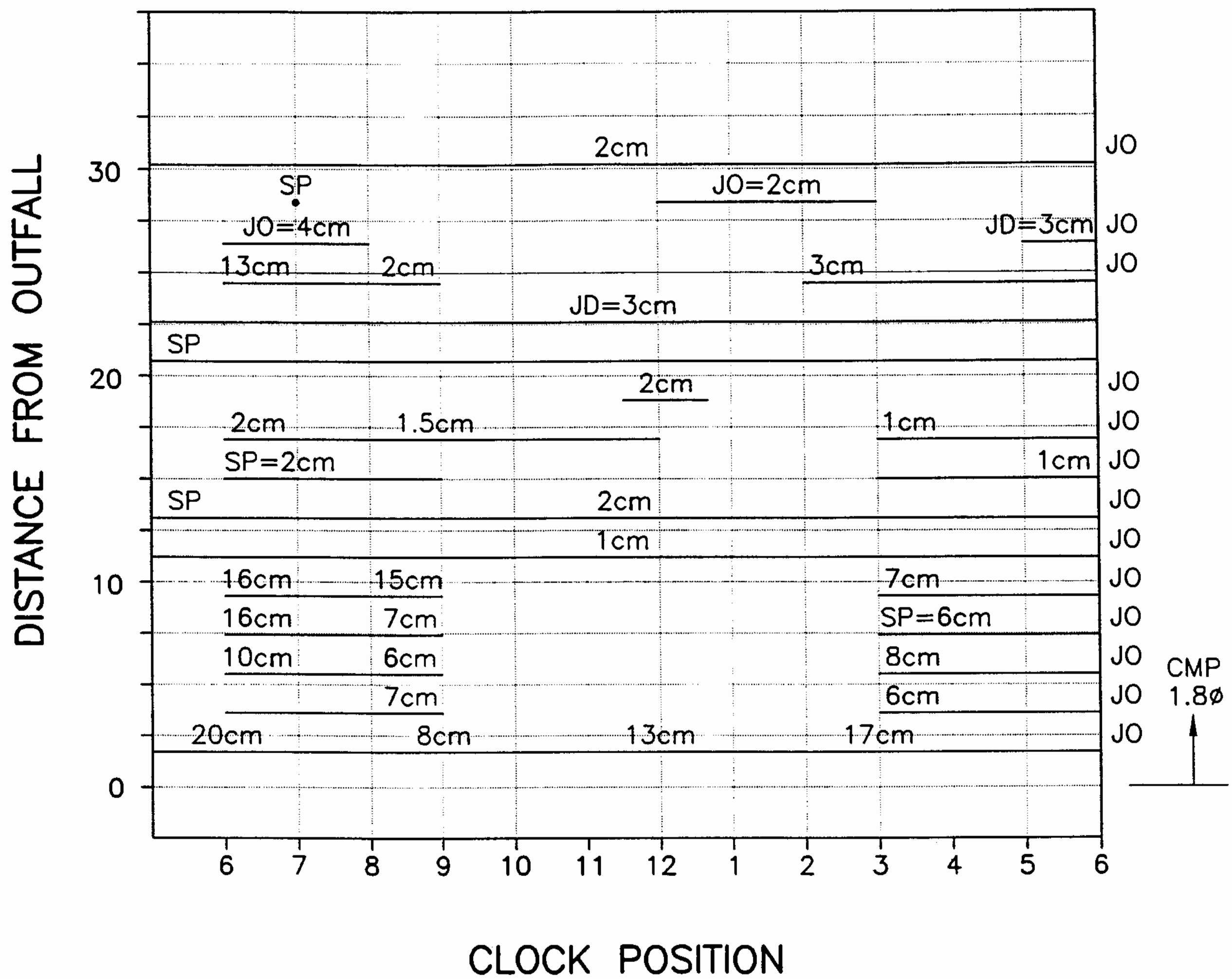
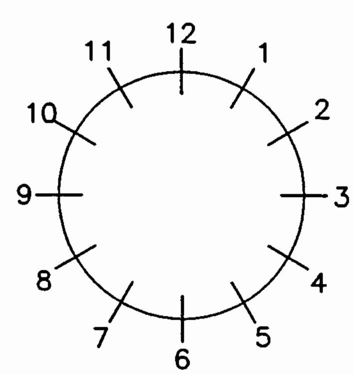
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A18	

KGS FILE NO.: 97–107–12A18

STRUCTURE CONDITION MAPPING CHART





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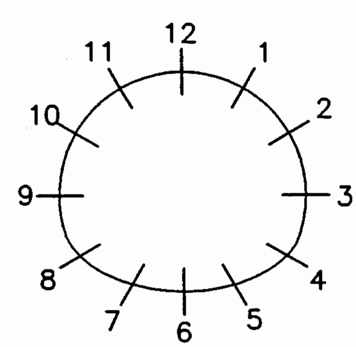

Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
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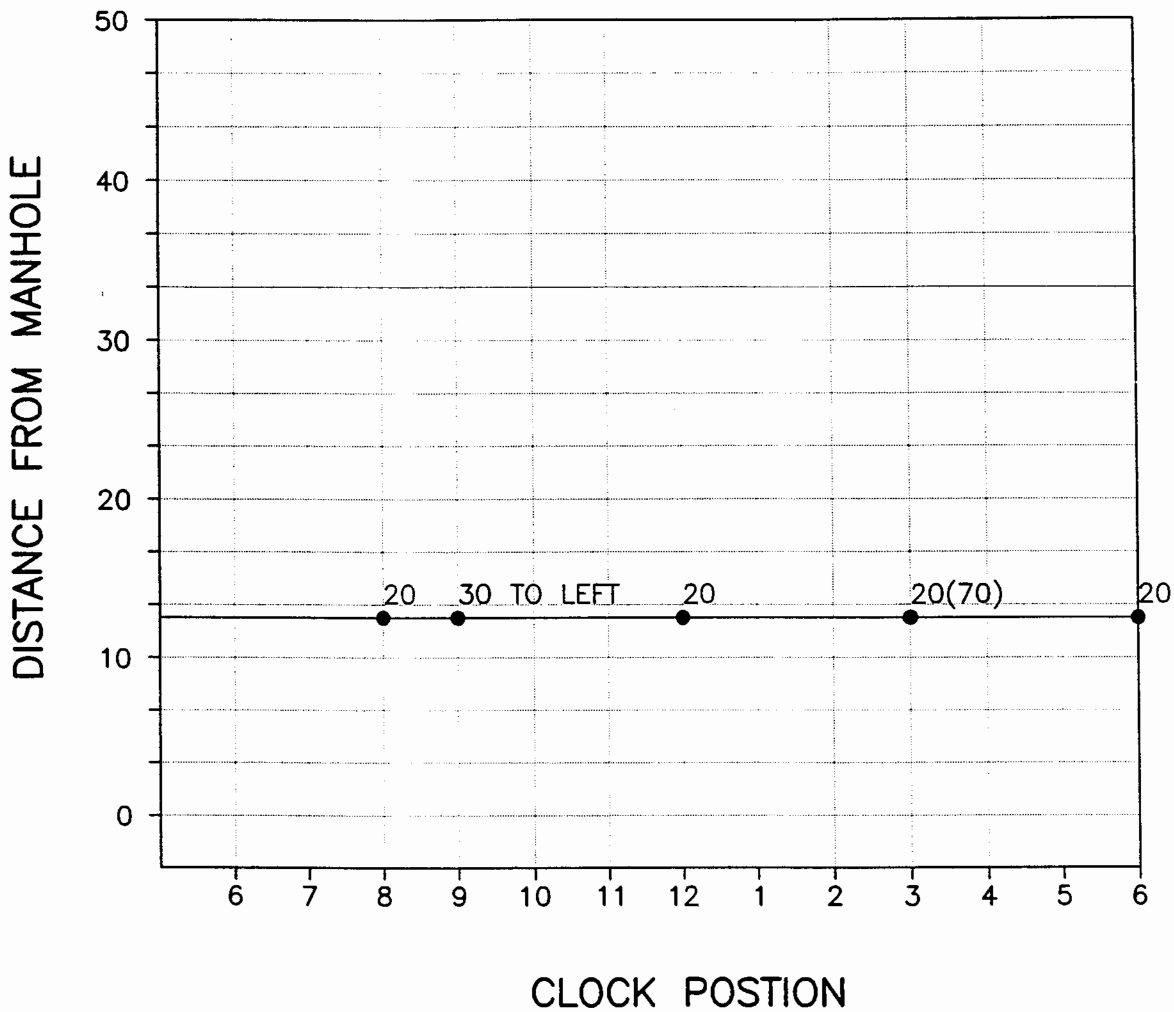
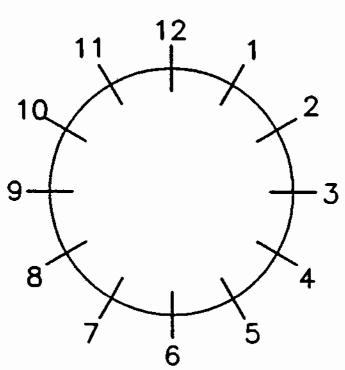
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A19	

KGS FILE NO.: 97-107-12A19

STRUCTURE CONDITION MAPPING CHART





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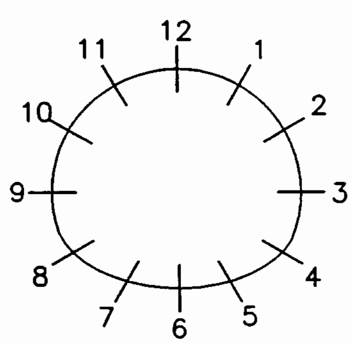

Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
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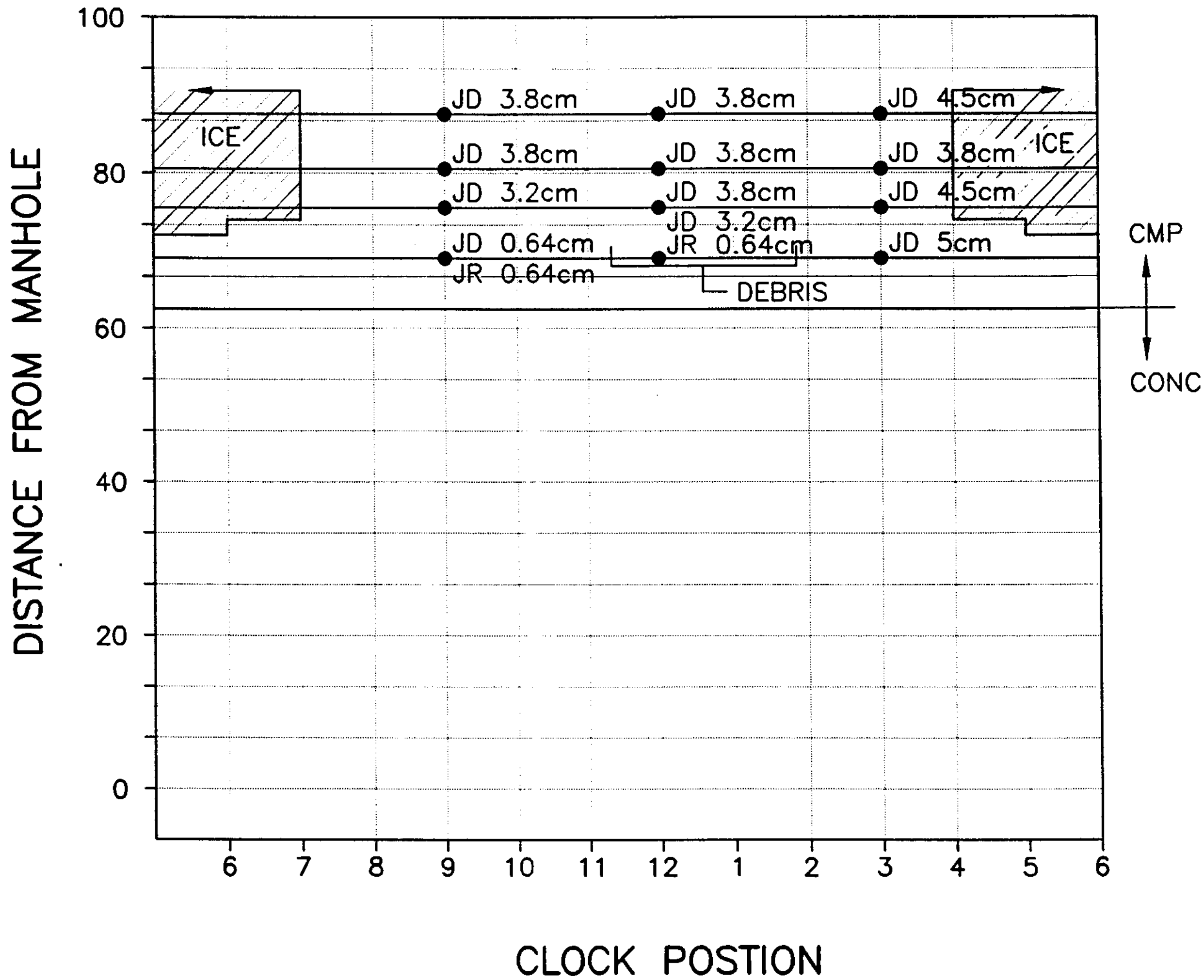
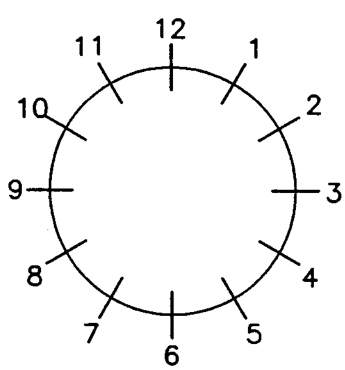
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A35	

STRUCTURE CONDITION MAPPING CHART





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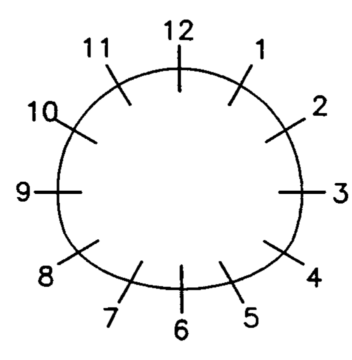


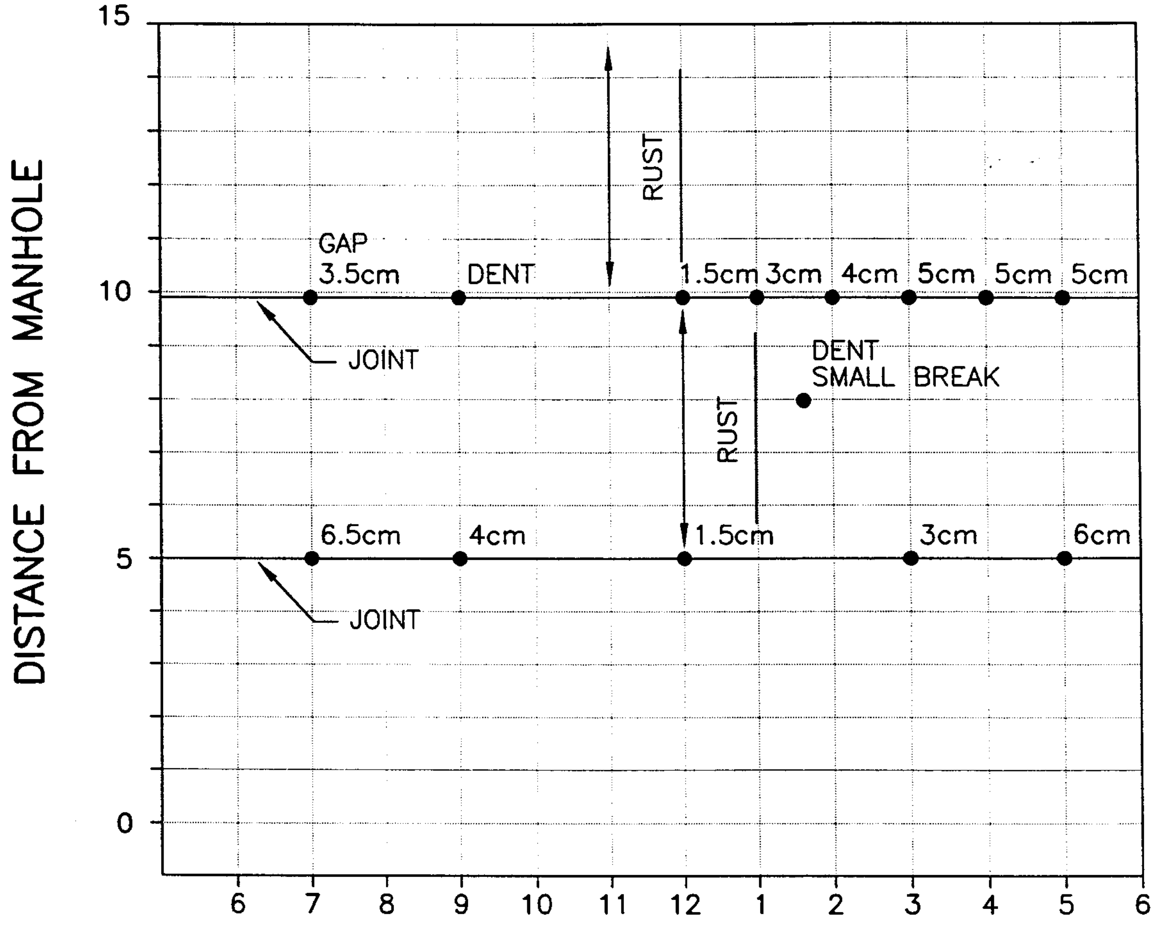
Clock Reference Looking
DOWNSTREAM

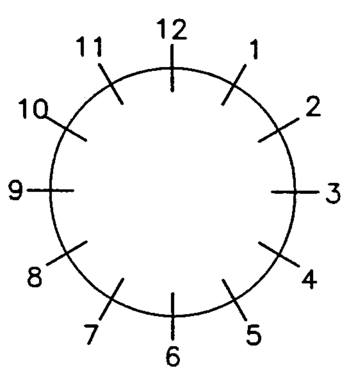
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A42	

KGS FILE NO.: 97-107-12A42

STRUCTURE CONDITION MAPPING CHART





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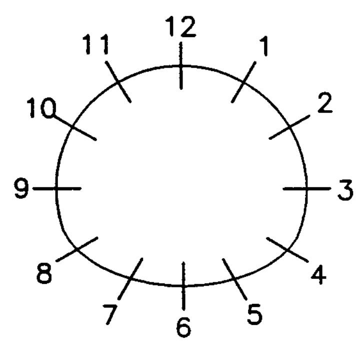


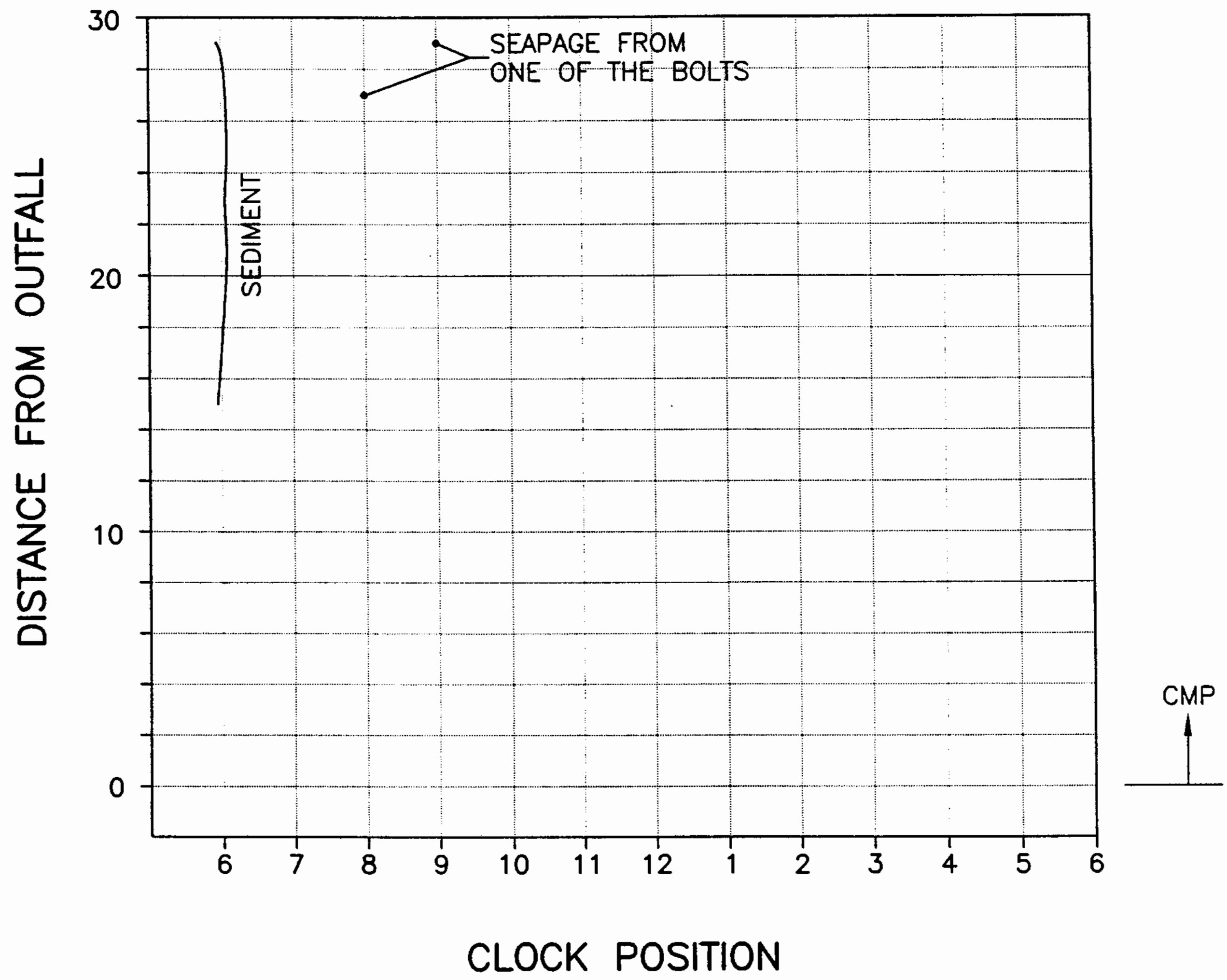
Clock Reference Looking
DOWNSTREAM

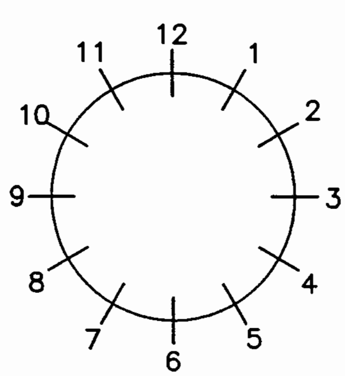
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A52	

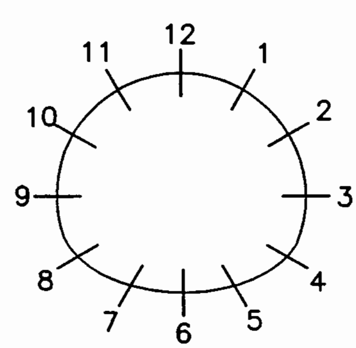
KGS FILE NO.: 97-107-12A52

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM

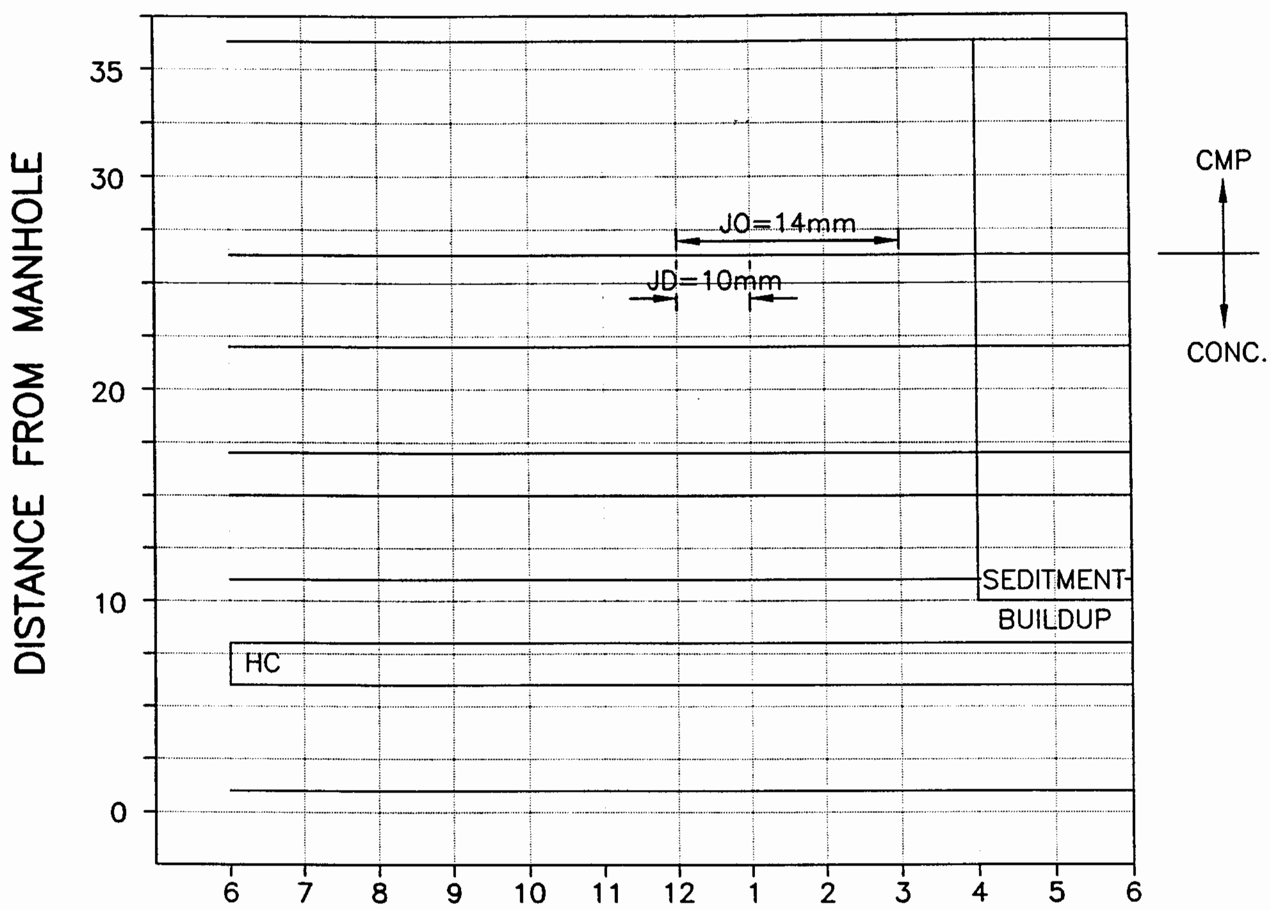


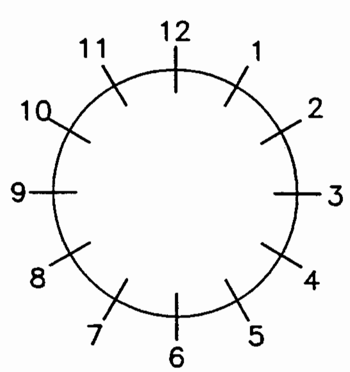
Clock Reference Looking
DOWNSTREAM

LEGEND:

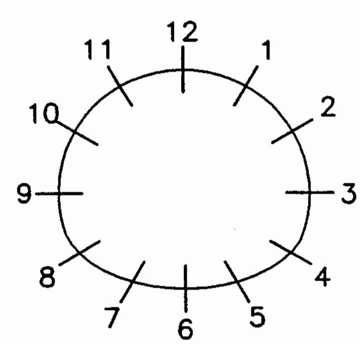
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A58	

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM

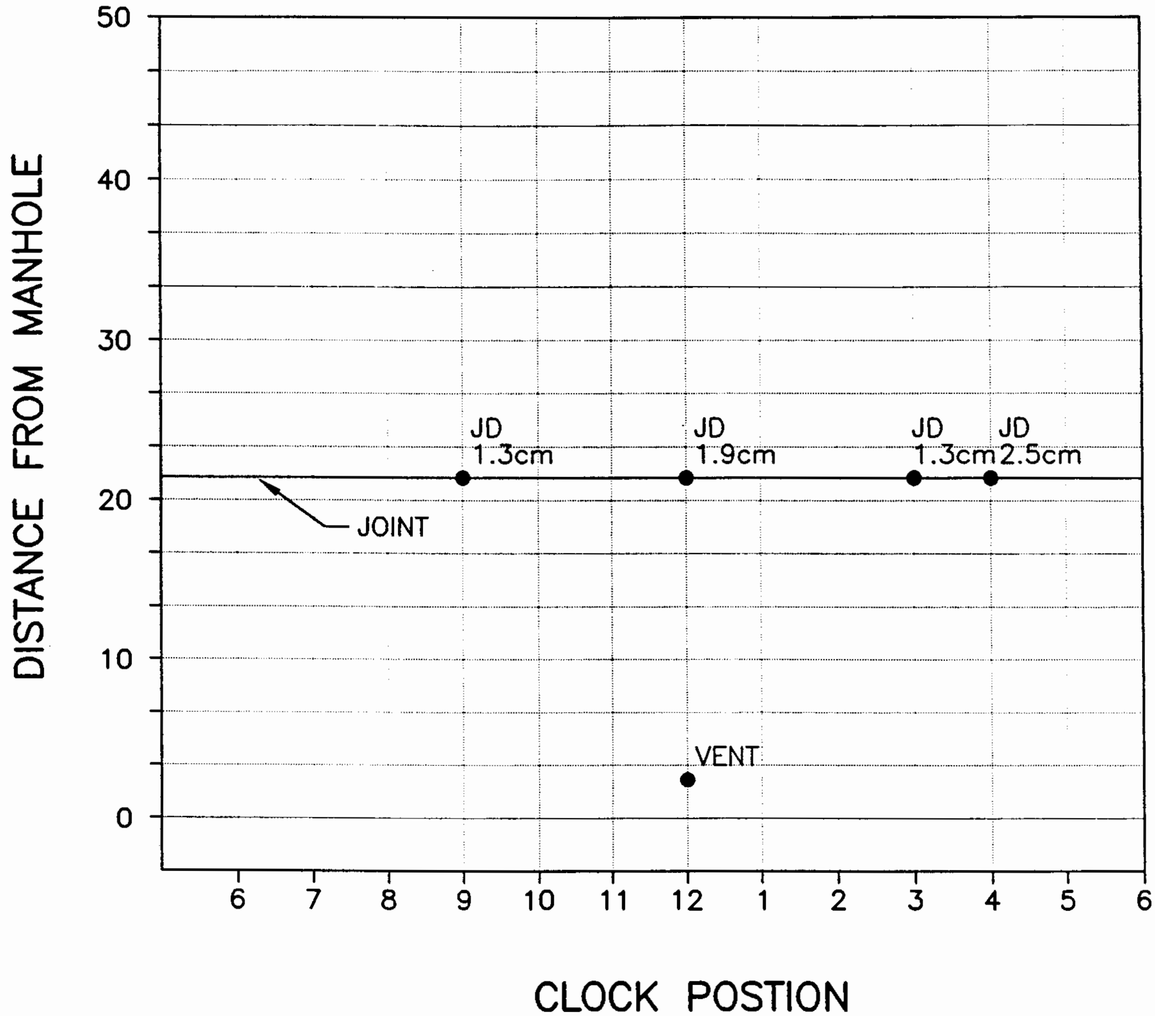


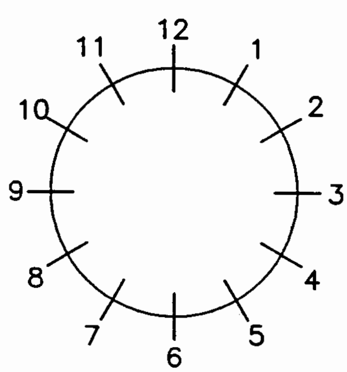
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A63	

STRUCTURE CONDITION MAPPING CHART





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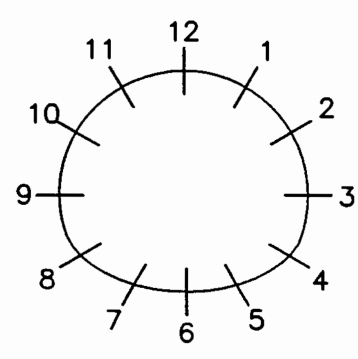


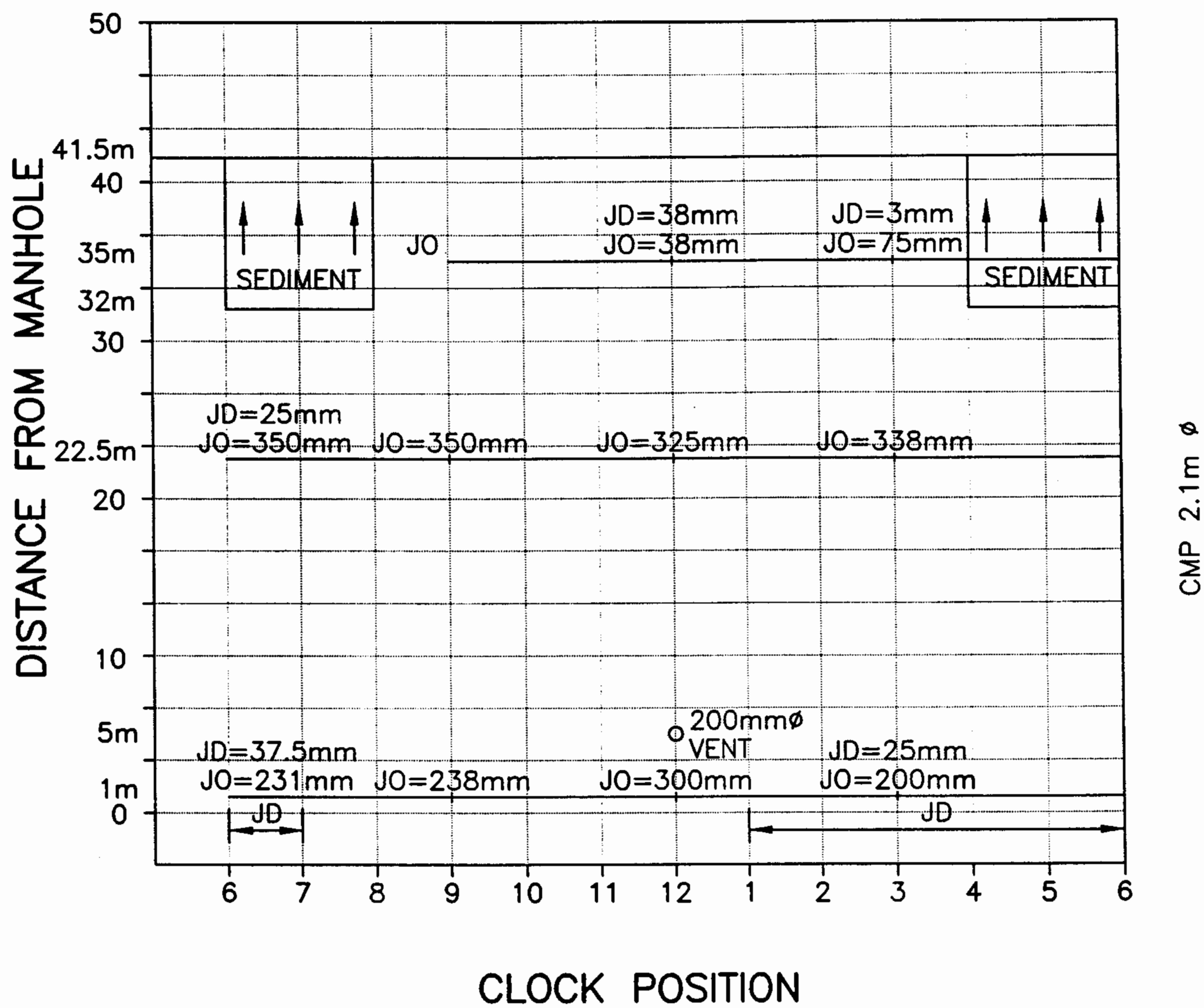
Clock Reference Looking DOWNSTREAM

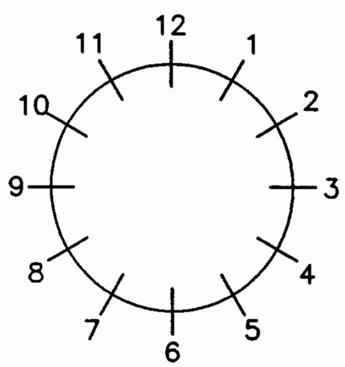
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A69	

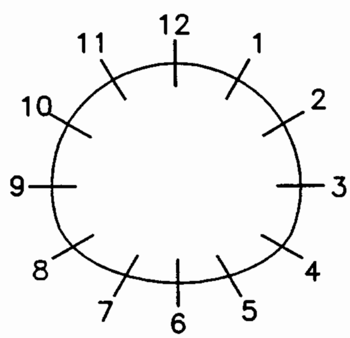
KGS FILE NO.: 97-107-12A69

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM

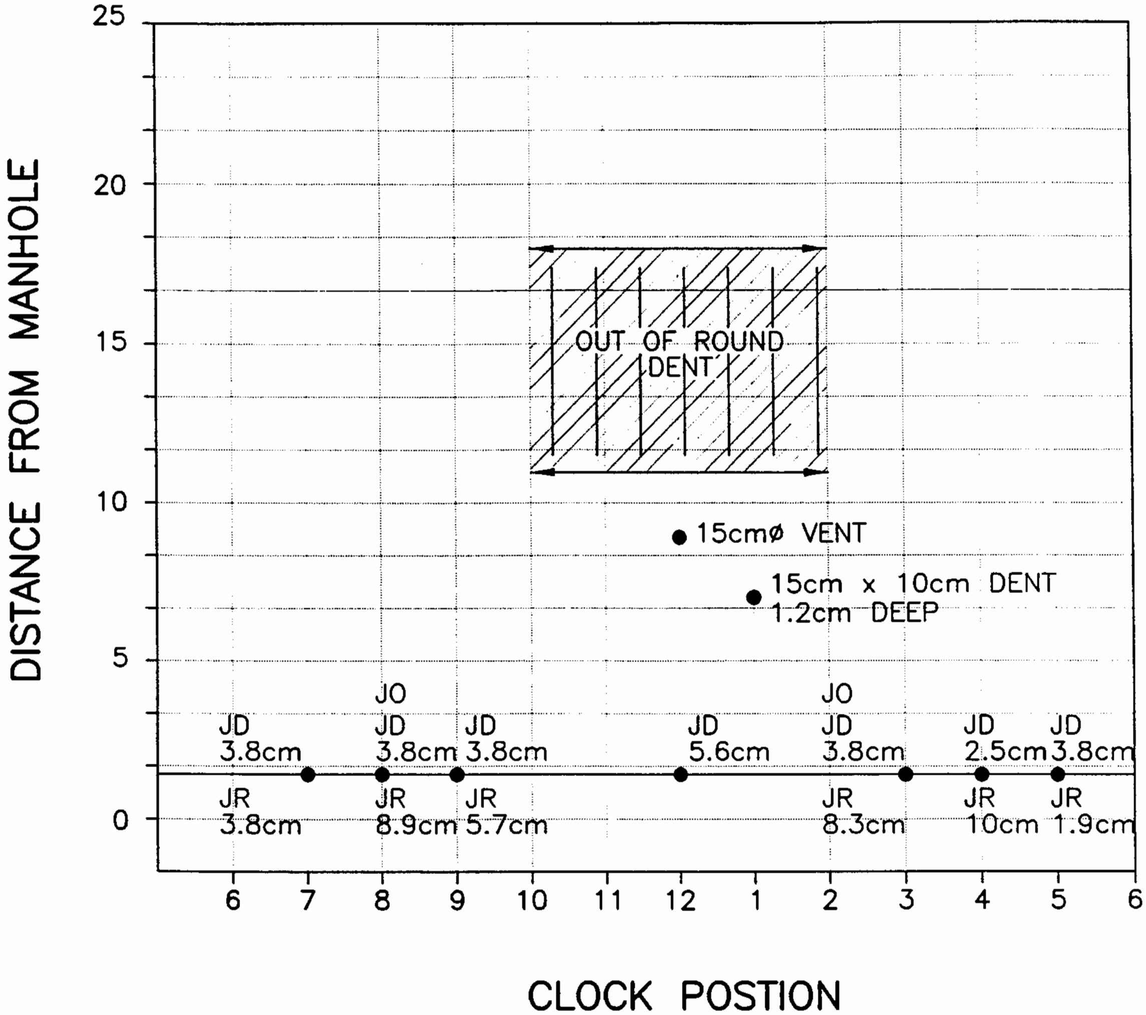


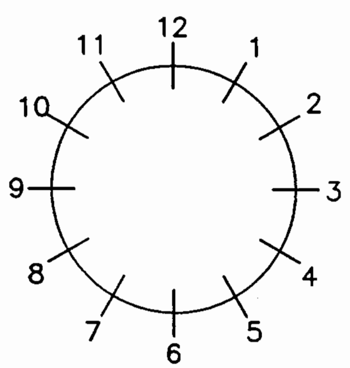
Clock Reference Looking DOWNSTREAM

LEGEND:

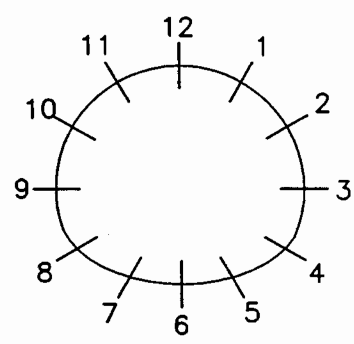
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A74	

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM

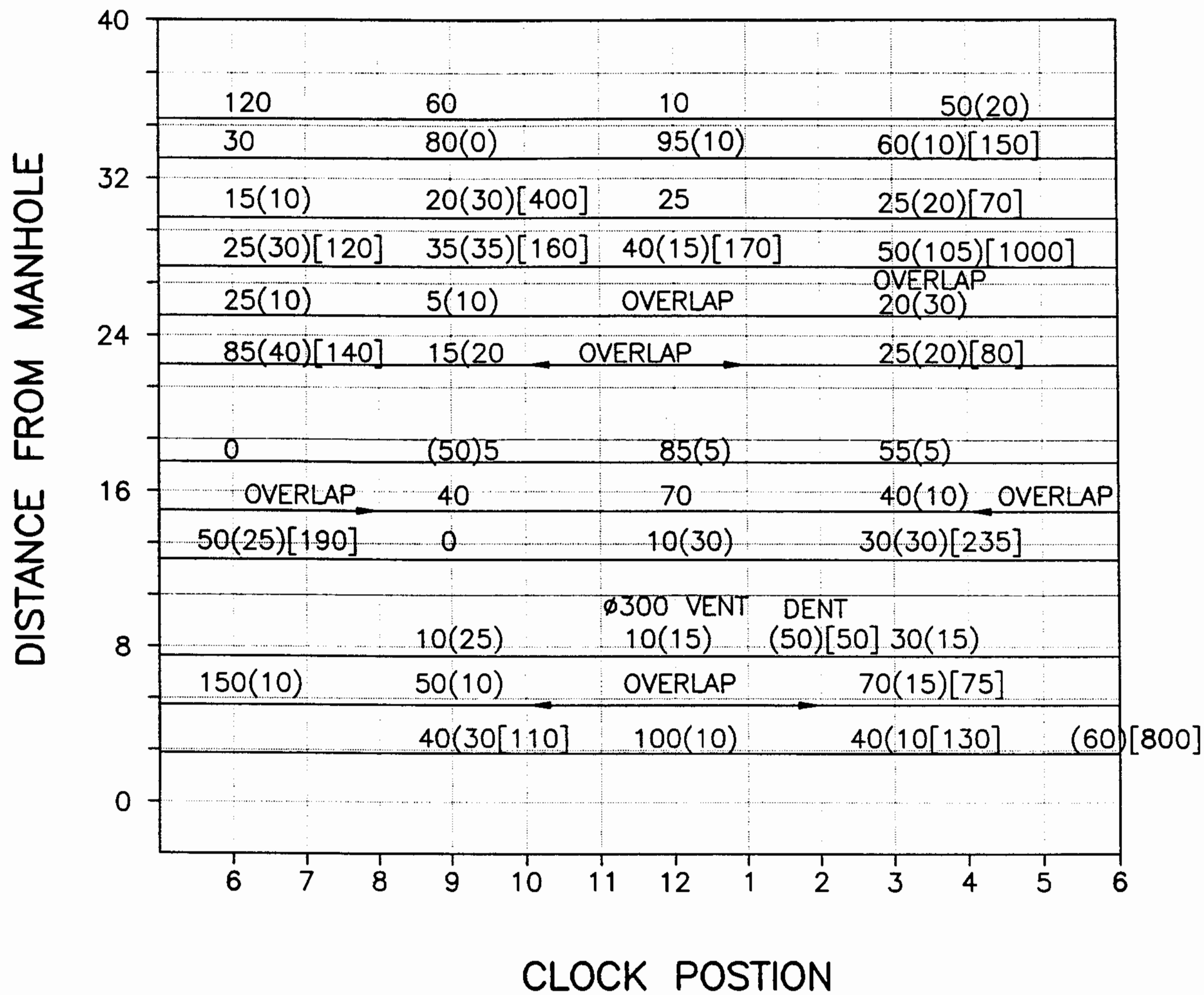


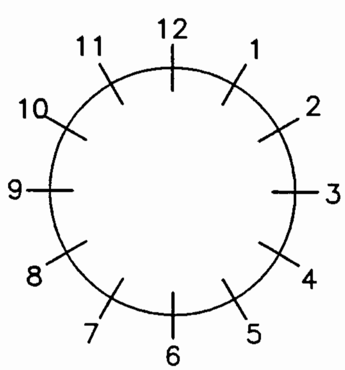
Clock Reference Looking
DOWNSTREAM

LEGEND:

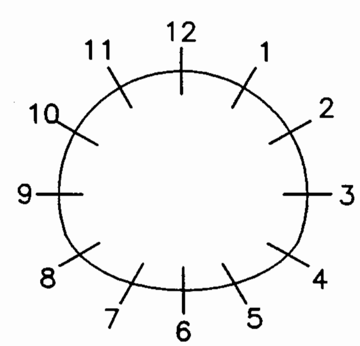
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A75	

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



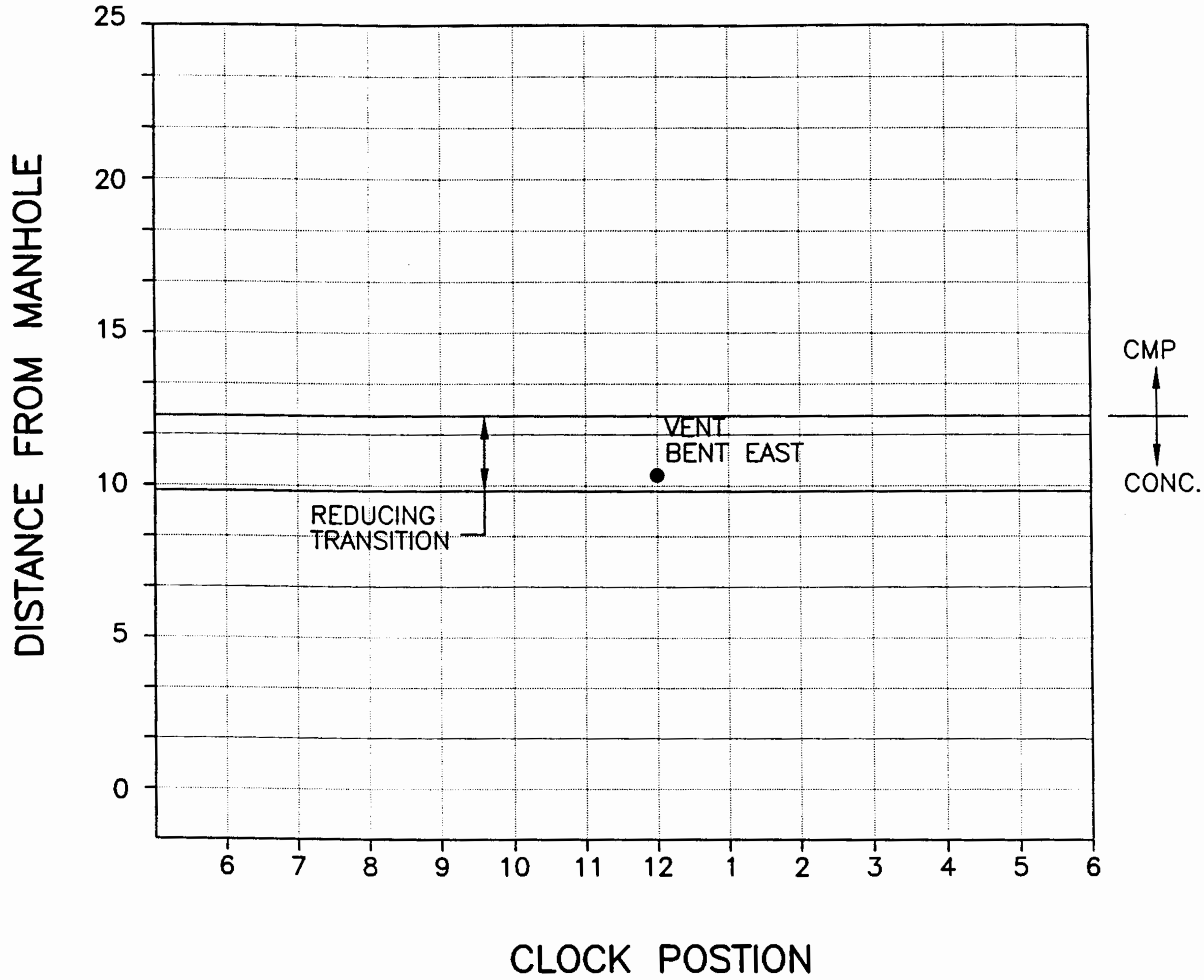
Clock Reference Looking DOWNSTREAM

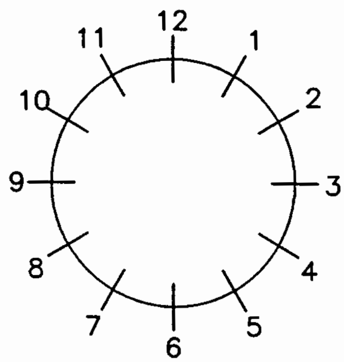
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A-76	

KGS FILE NO.: 97-107-12A76

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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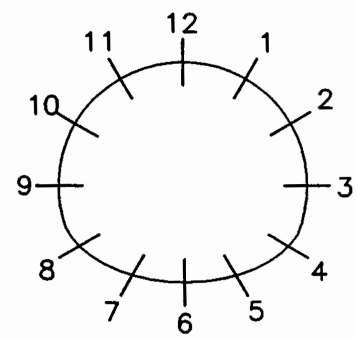


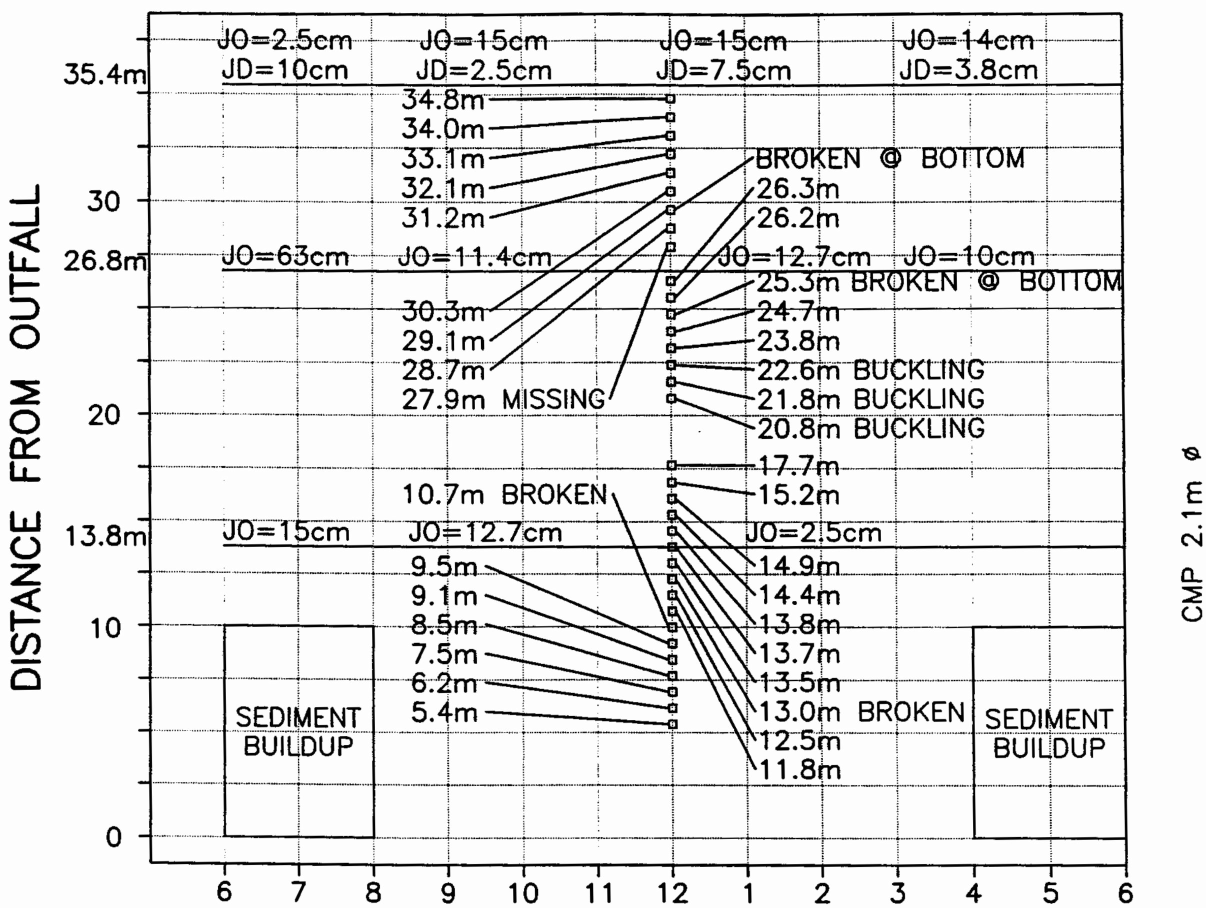
Clock Reference Looking
DOWNSTREAM

LEGEND:

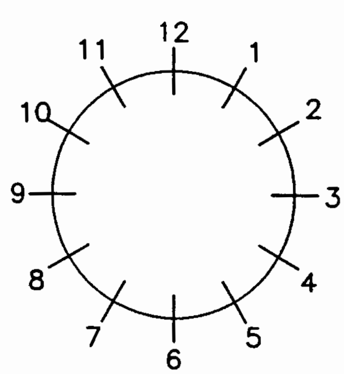
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A80	

KGS FILE NO.: 97-107-12A80

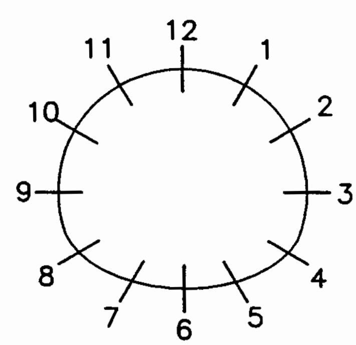
STRUCTURE CONDITION MAPPING CHART



▫11.8m – WOOD BRACE AND DISTANCE FROM OUTLET



Clock Reference Looking DOWNSTREAM

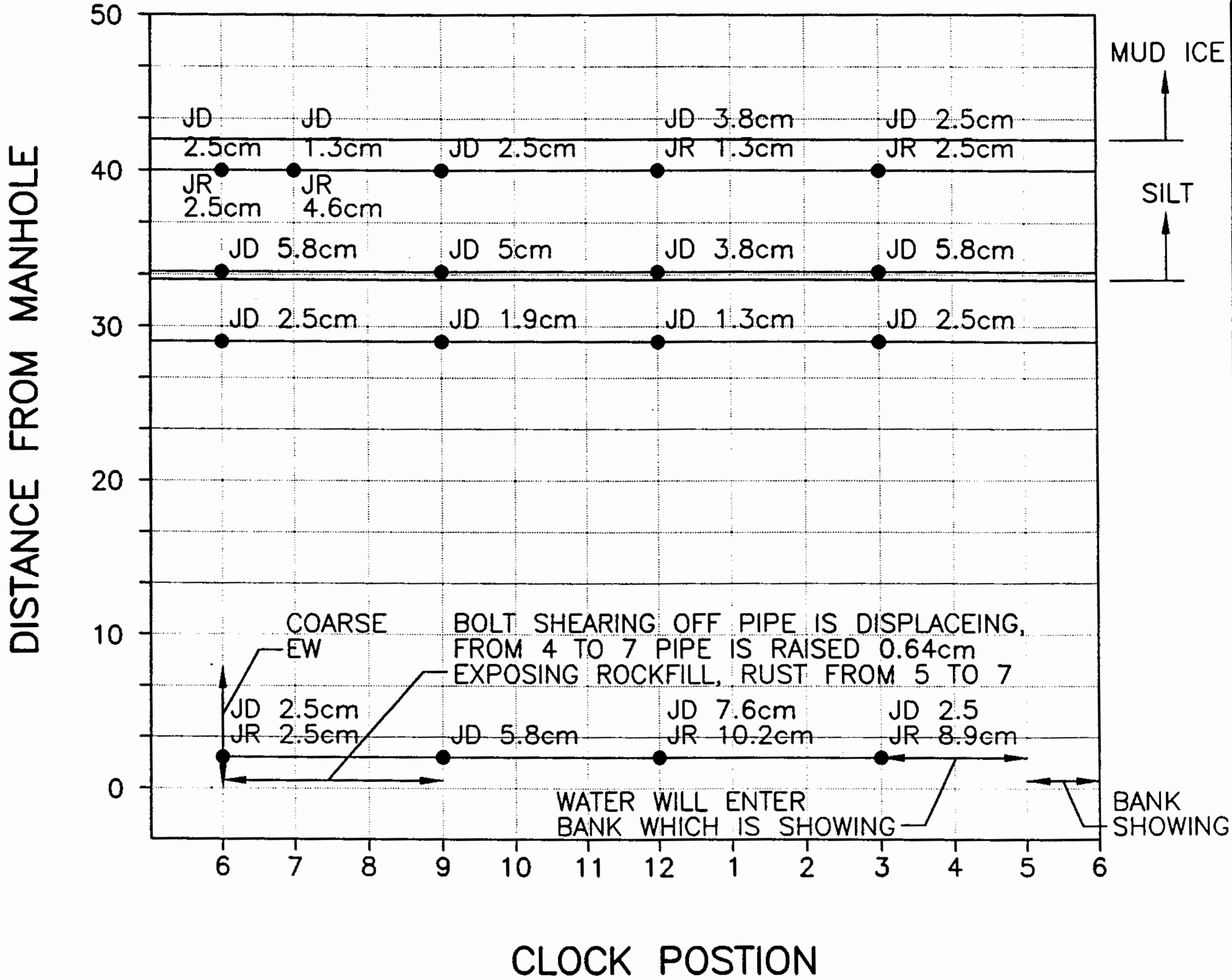


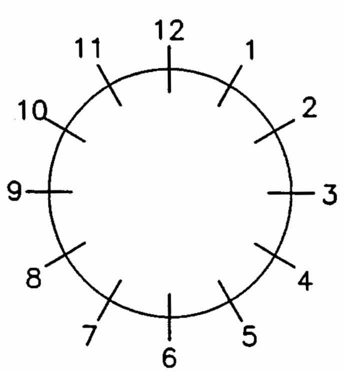
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A81	

STRUCTURE CONDITION MAPPING CHART





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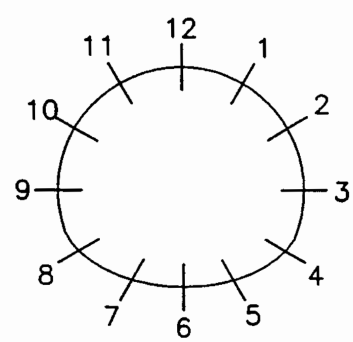
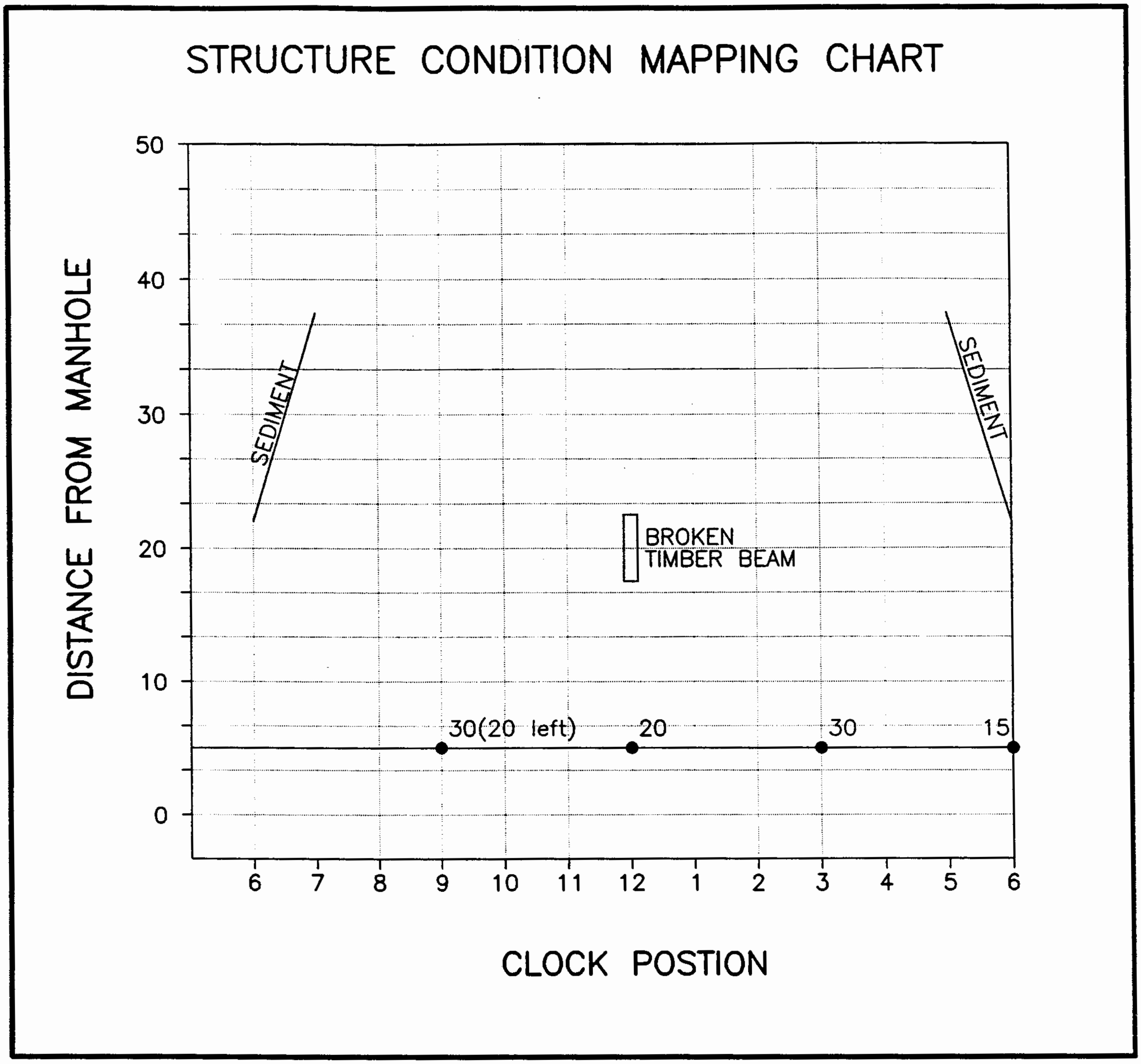


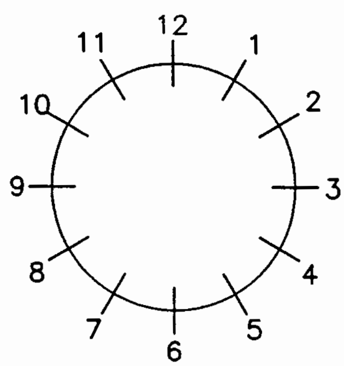
Clock Reference Looking
DOWNSTREAM

LEGEND:

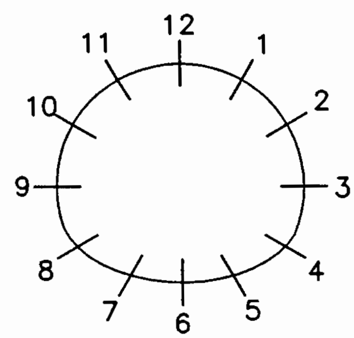
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A86	

KGS FILE NO.: 97-107-12A86





Clock Reference Looking
DOWNSTREAM



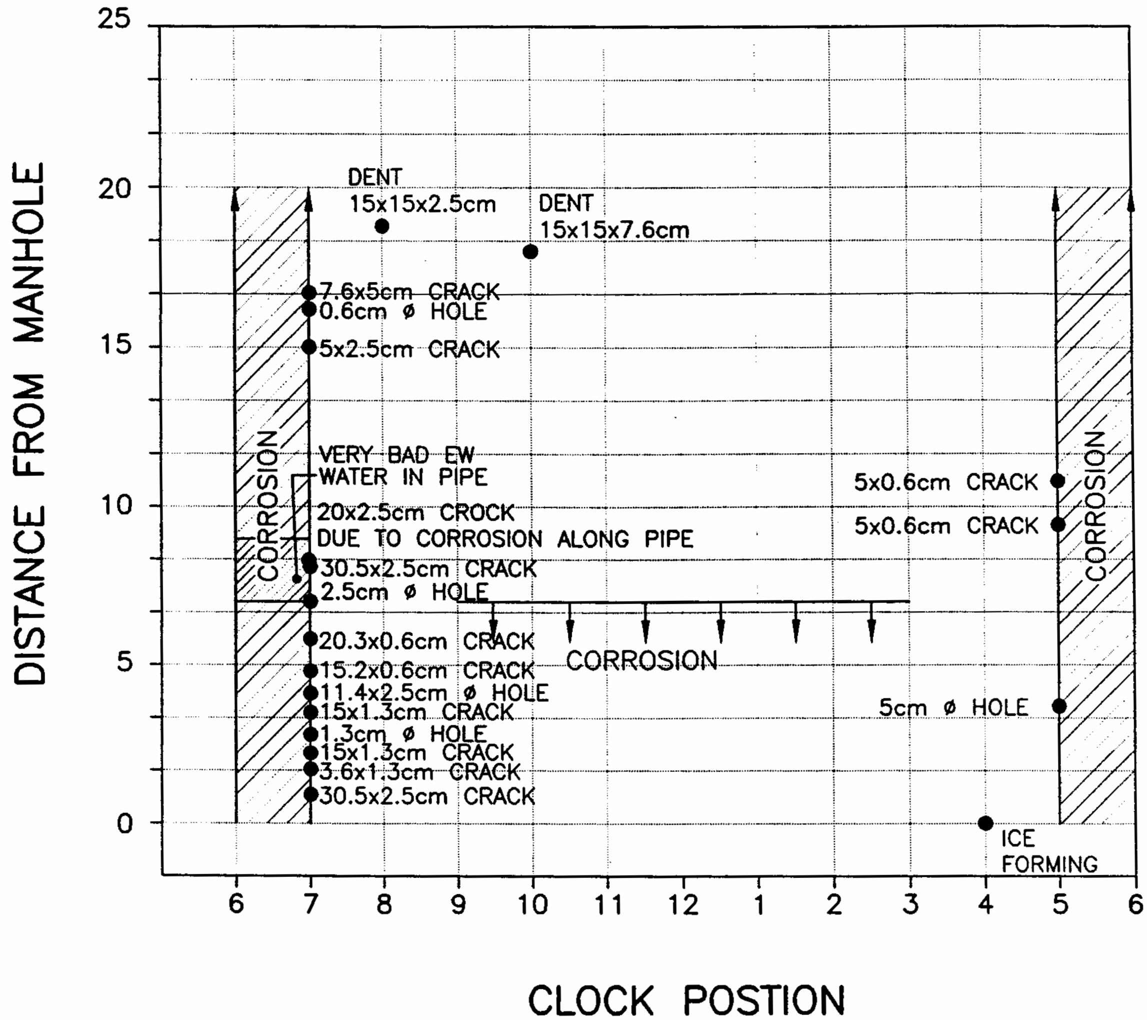
Clock Reference Looking
DOWNSTREAM

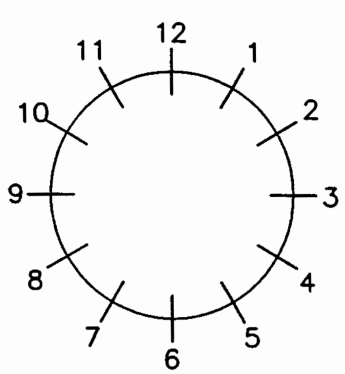
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A87	

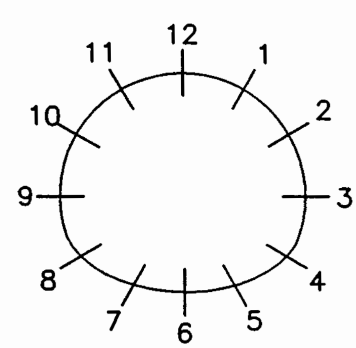
KGS FILE NO.: 97-107-12A87

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



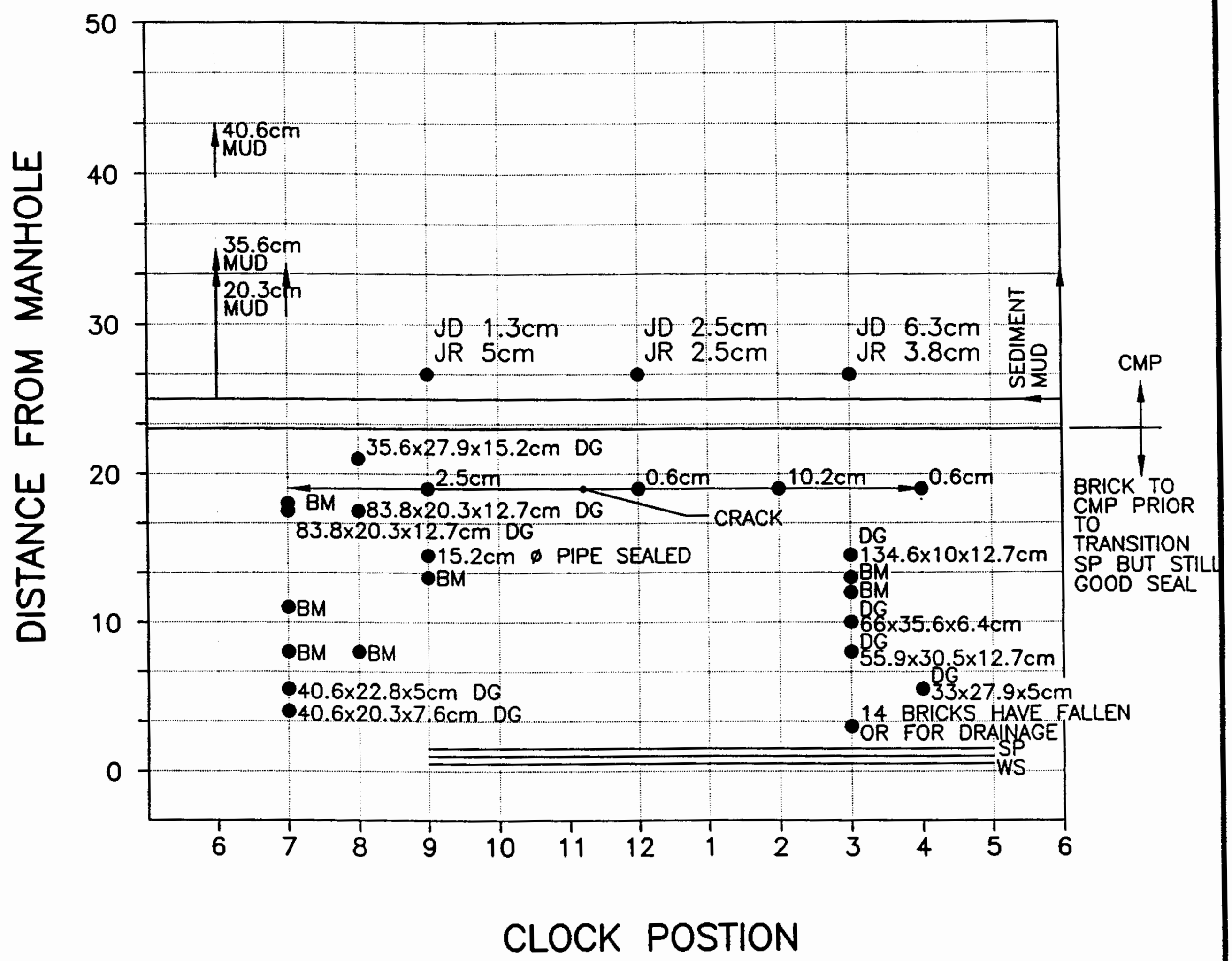
Clock Reference Looking
DOWNSTREAM

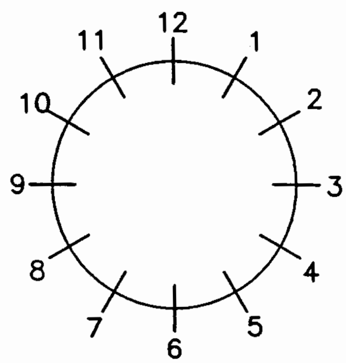
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A88	

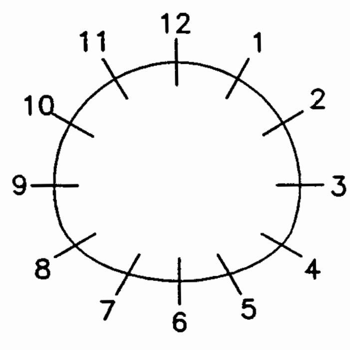
KCS FILE NO.: 97-107-12A88

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



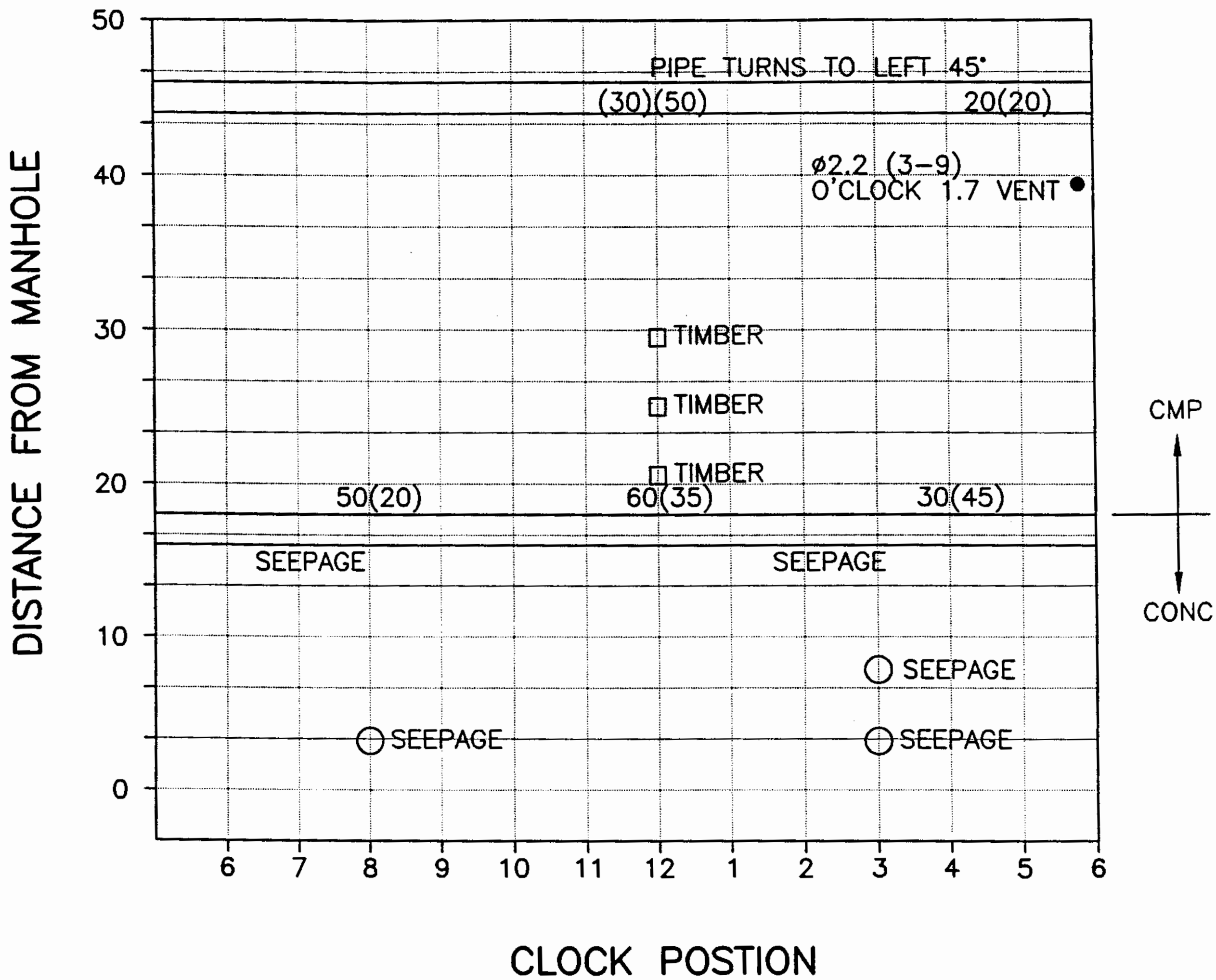
Clock Reference Looking DOWNSTREAM

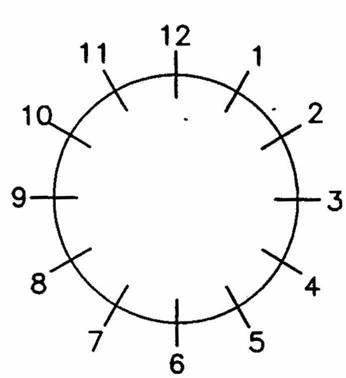
LEGEND:

DEFECTIVE CONCRETE:				JOINTS:		
DG DEEP GAP	Spalling	SP			Raised	JR
BM BRICK MISSING	Honeycomb	HC			Displaced	JD
WS WATER SEEPAGE	Erosion/Wear	EW			Spalled	SP
	Delaminated	DC		PIPE IDENTIFICATION:	A90	

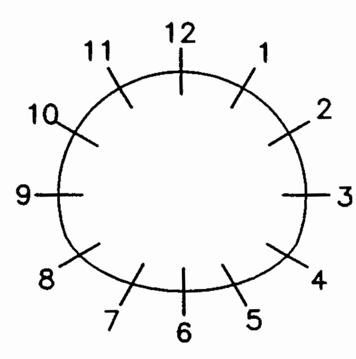
KGS FILE NO.: 97-107-12A90

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



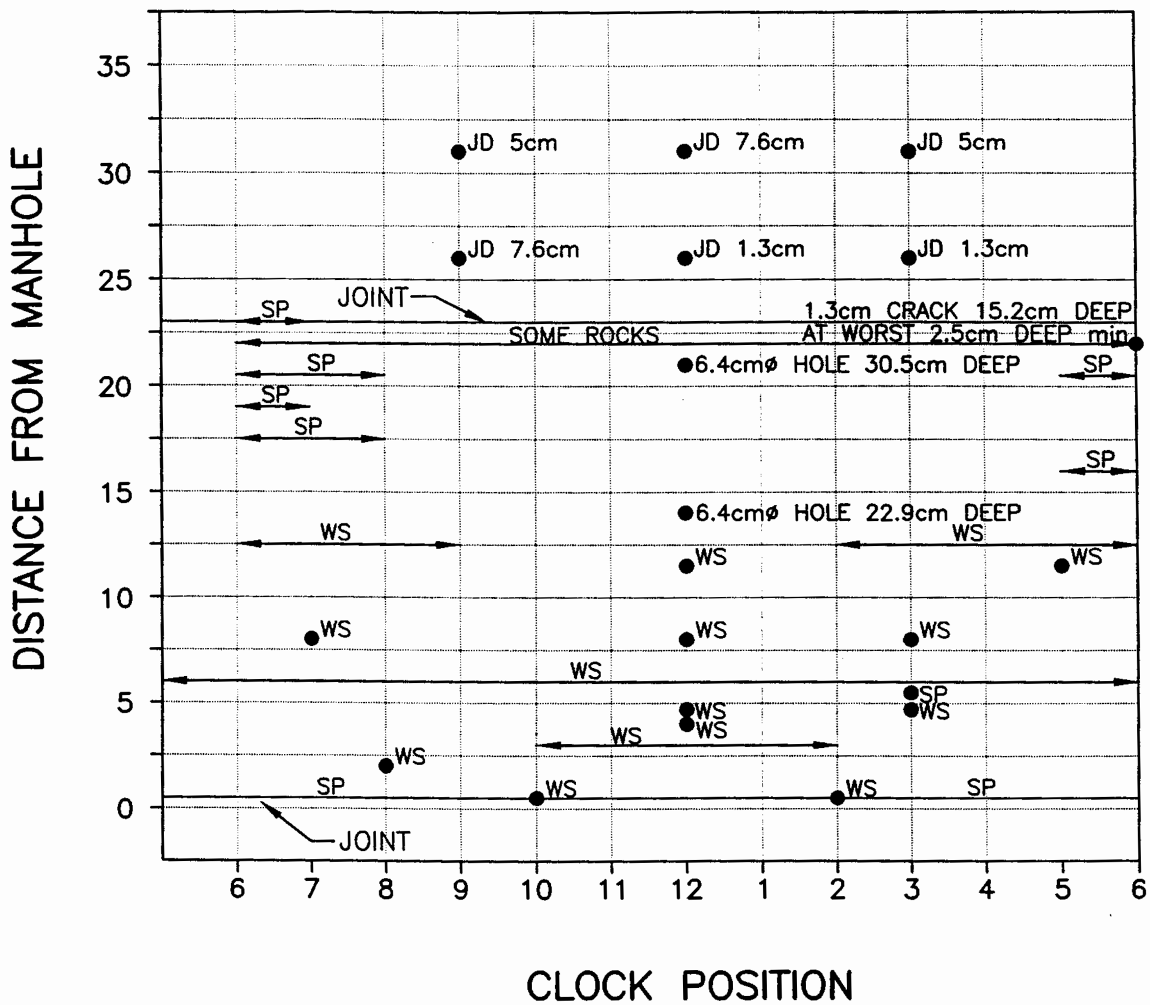
Clock Reference Looking DOWNSTREAM

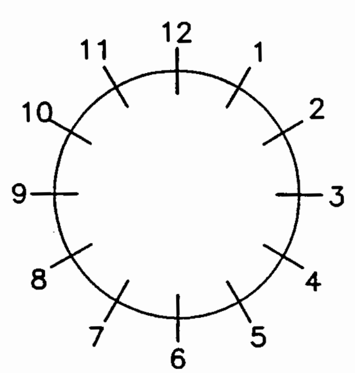
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A94	

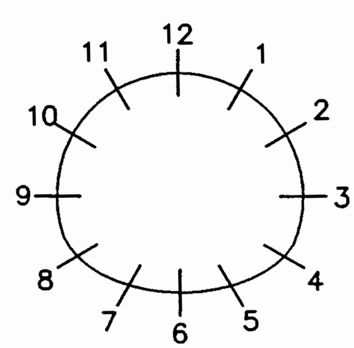
KGS FILE NO.: 97-107-12A94

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



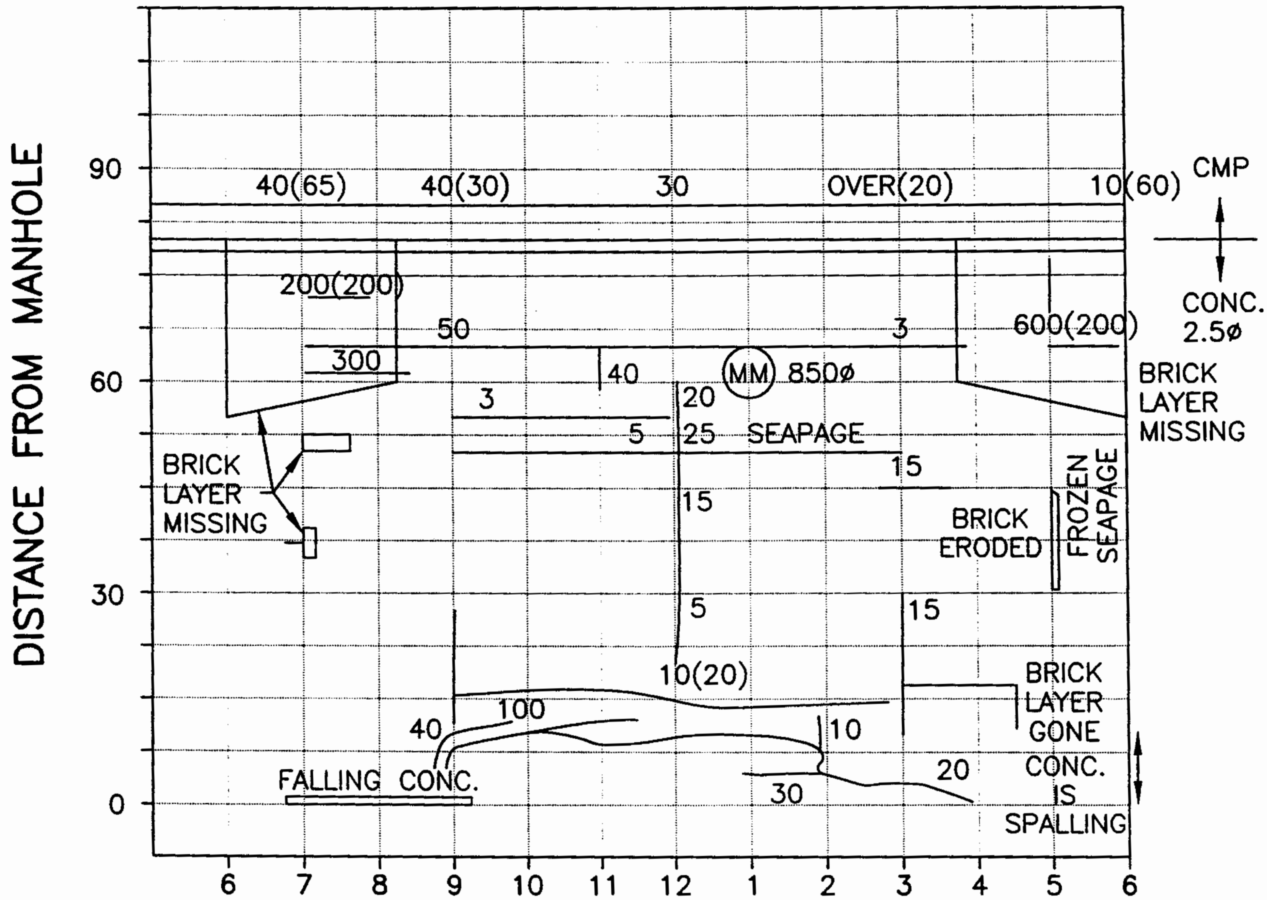
Clock Reference Looking
DOWNSTREAM

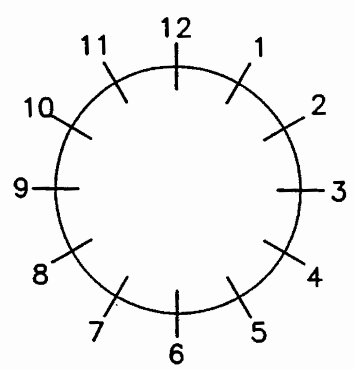
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A95	

SEINE RIVER

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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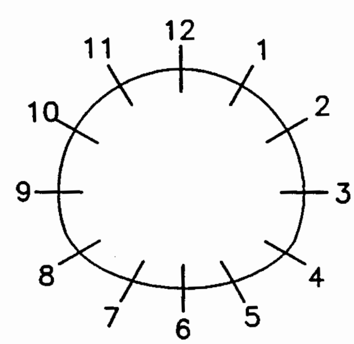


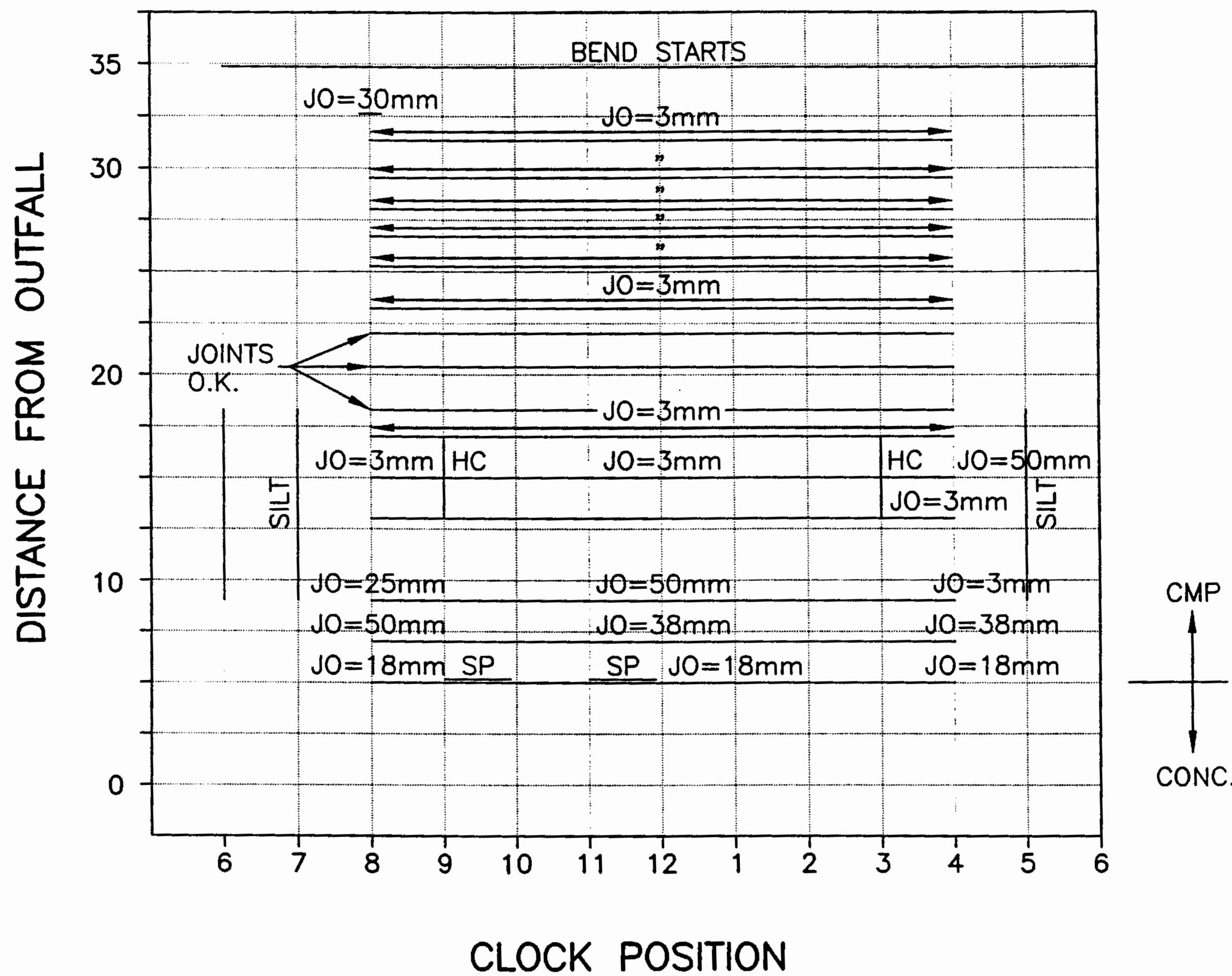
Clock Reference Looking
DOWNSTREAM

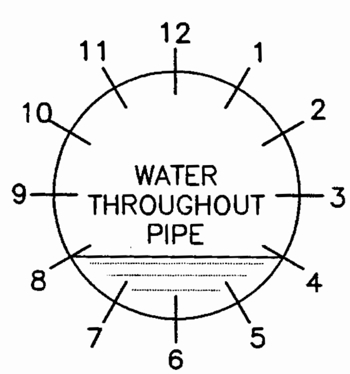
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	SE1	

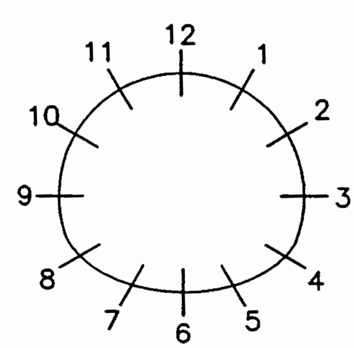
KGS FILE NO.: 97-107-12SE1

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



Clock Reference Looking
DOWNSTREAM

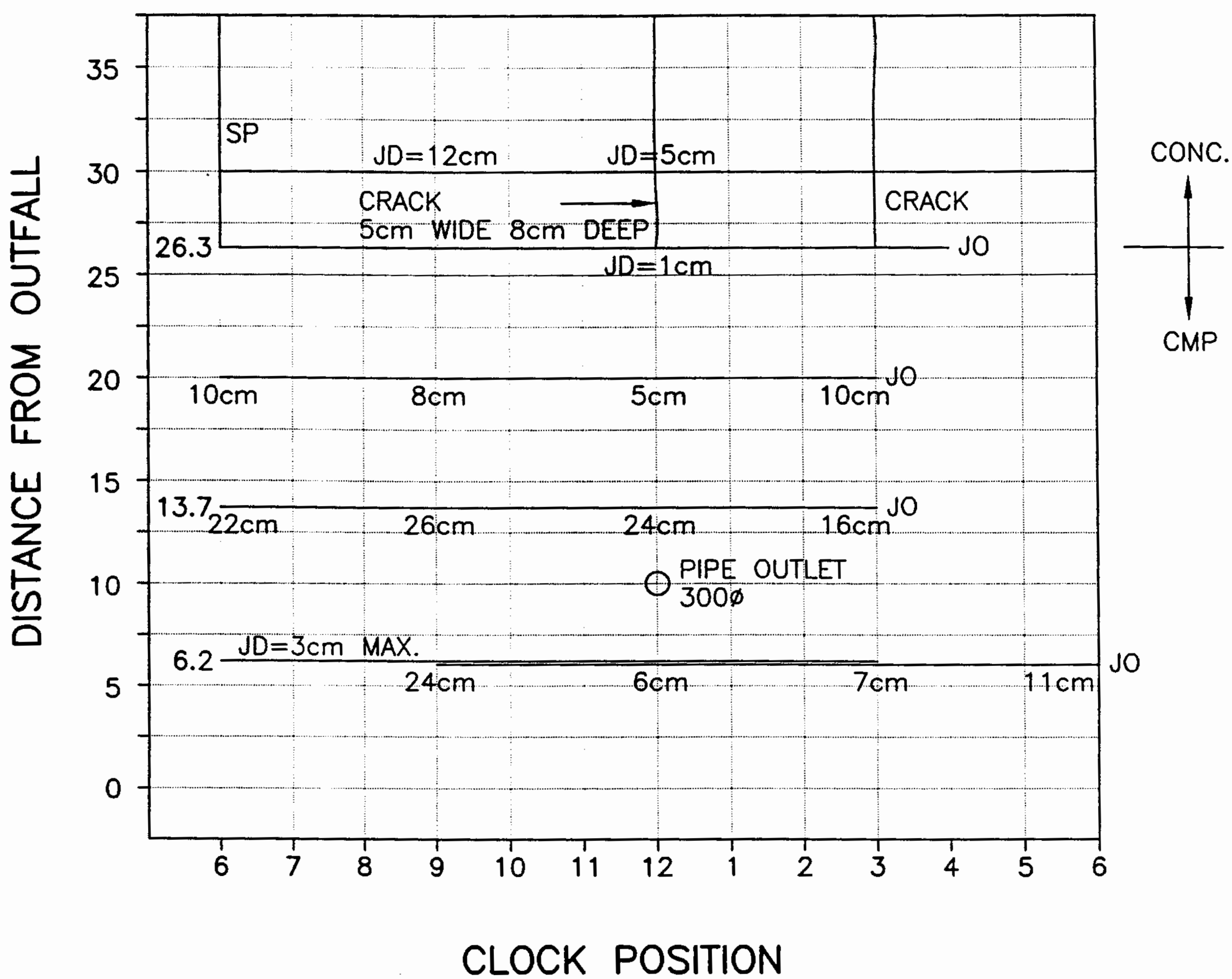
LEGEND:

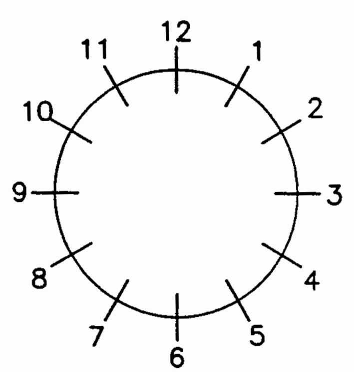
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	SE34	

KGS FILE NO.: 97-107-12SE34

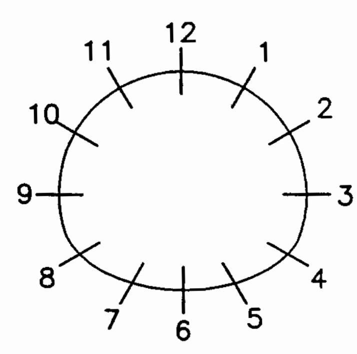
STURGEON CREEK

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



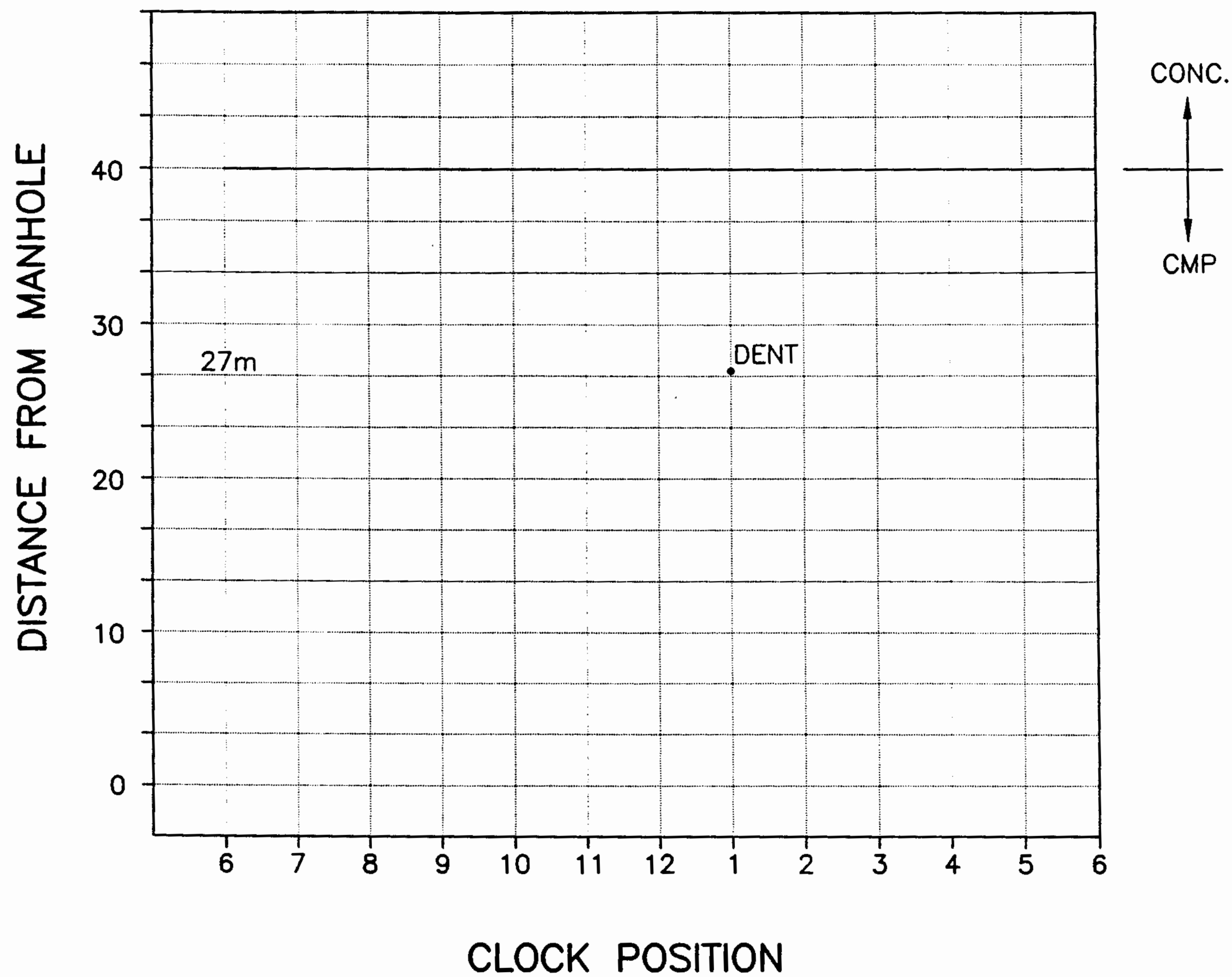
Clock Reference Looking
DOWNSTREAM

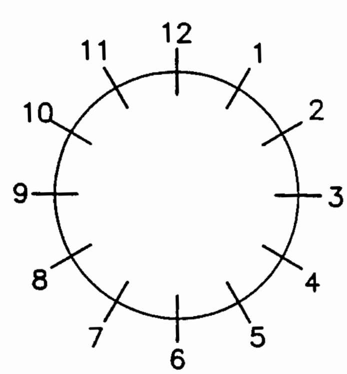
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	ST3	

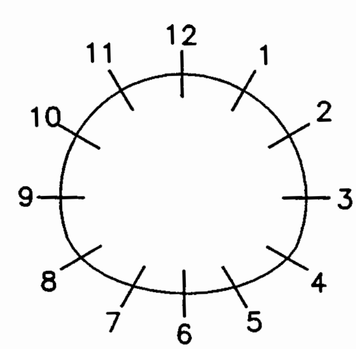
KGS FILE NO.: 97-107-12ST3

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM

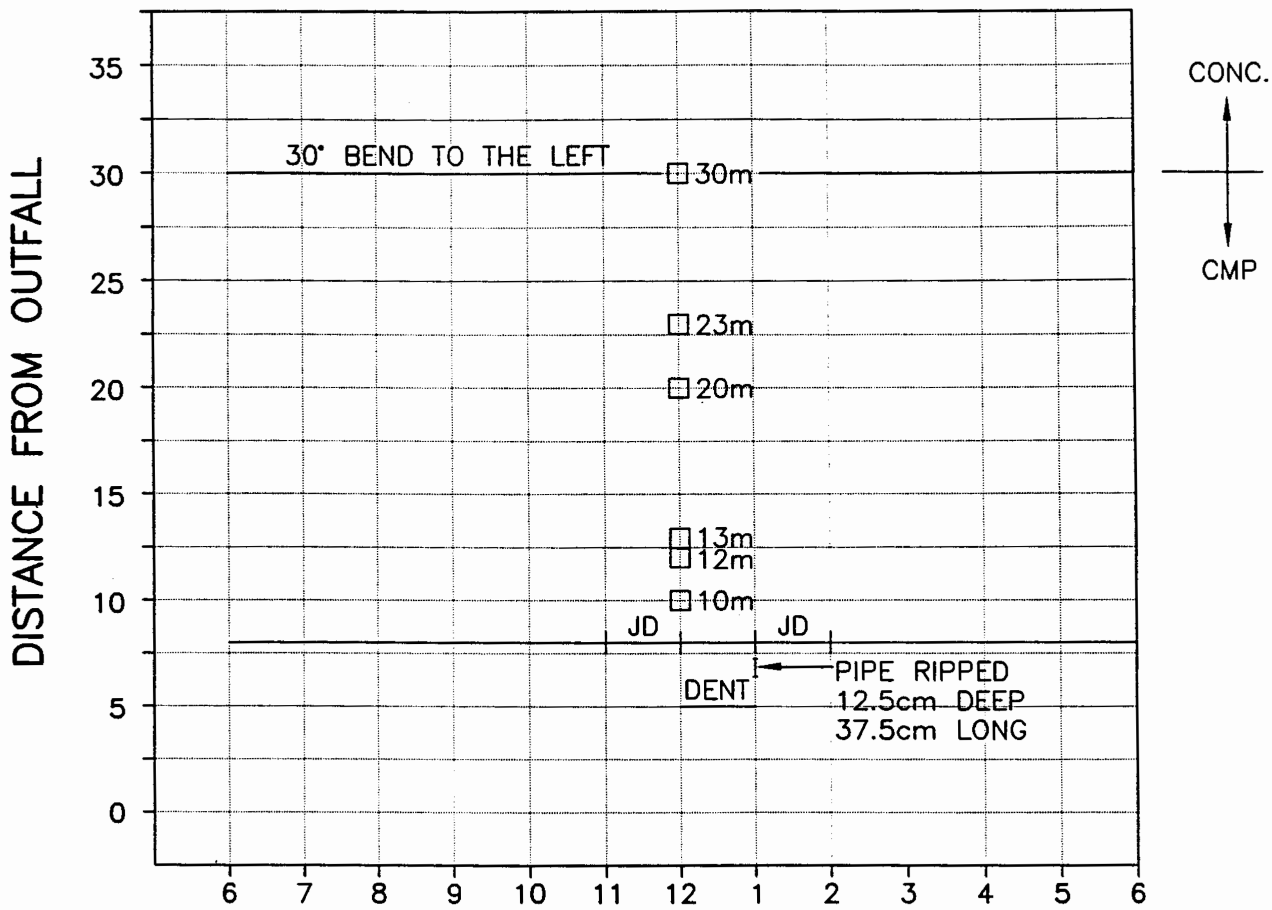


Clock Reference Looking
DOWNSTREAM

LEGEND:

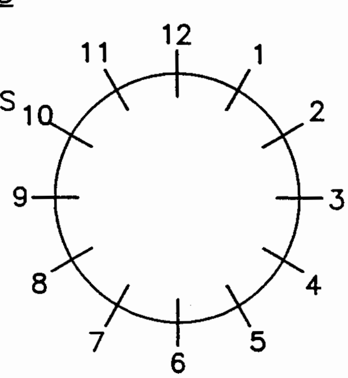
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	ST18	

STRUCTURE CONDITION MAPPING CHART

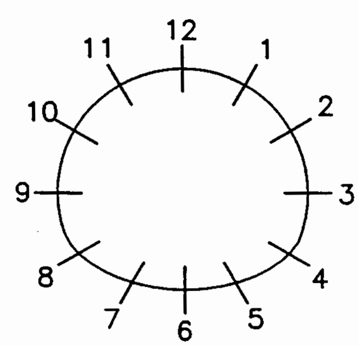


LEGEND

☐ 4"x4" WOOD BRACES



Clock Reference Looking DOWNSTREAM



Clock Reference Looking DOWNSTREAM

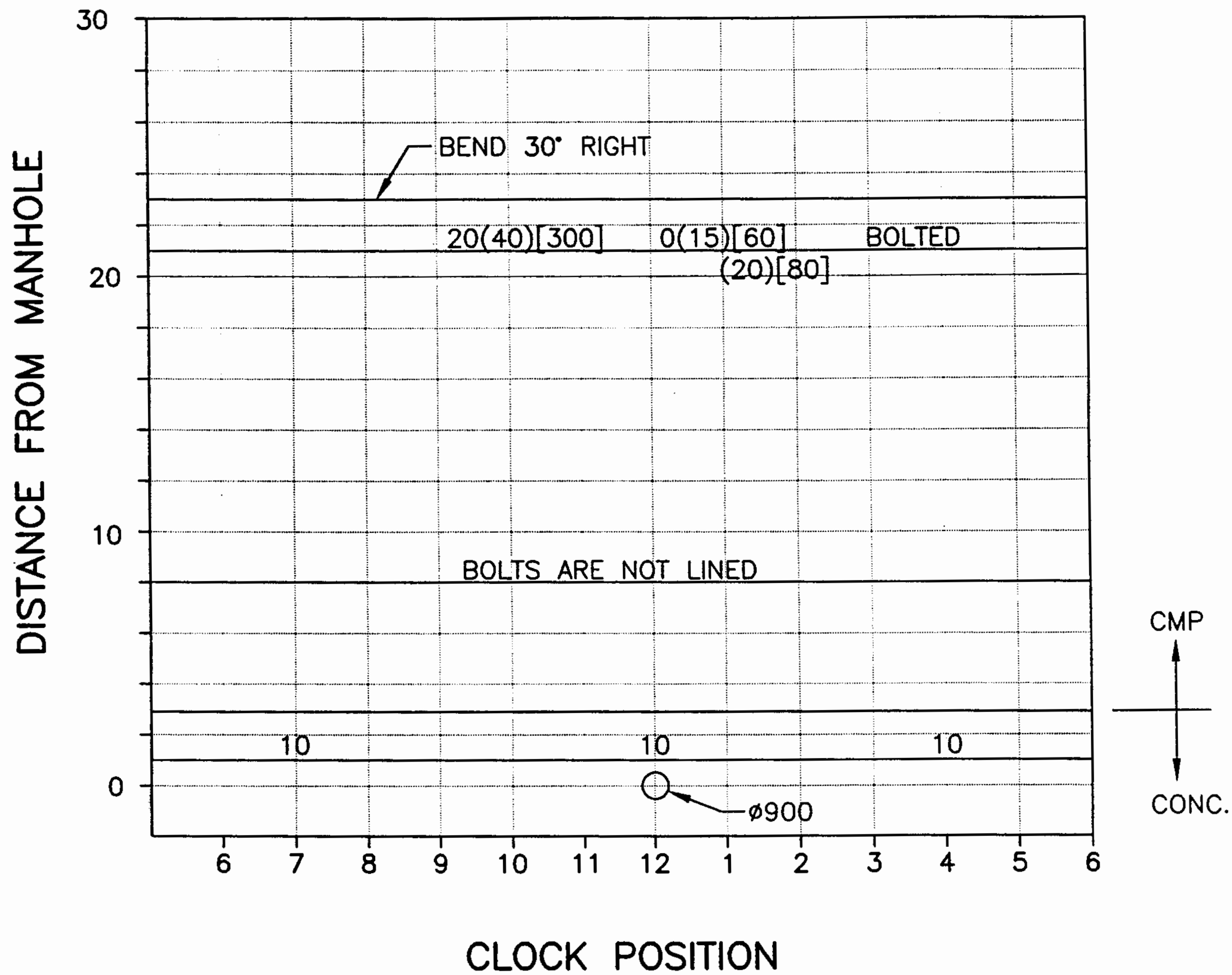
LEGEND:

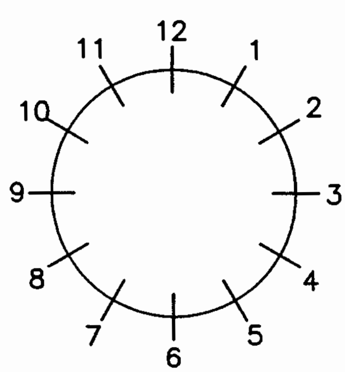
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	ST21	

KGS FILE NO.: 97-107-12ST21

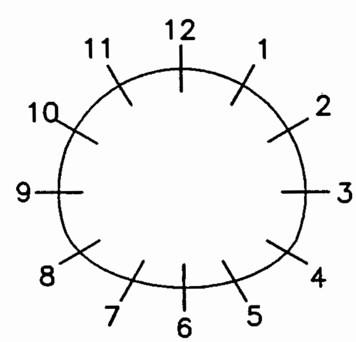
BUNN'S CREEK

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM

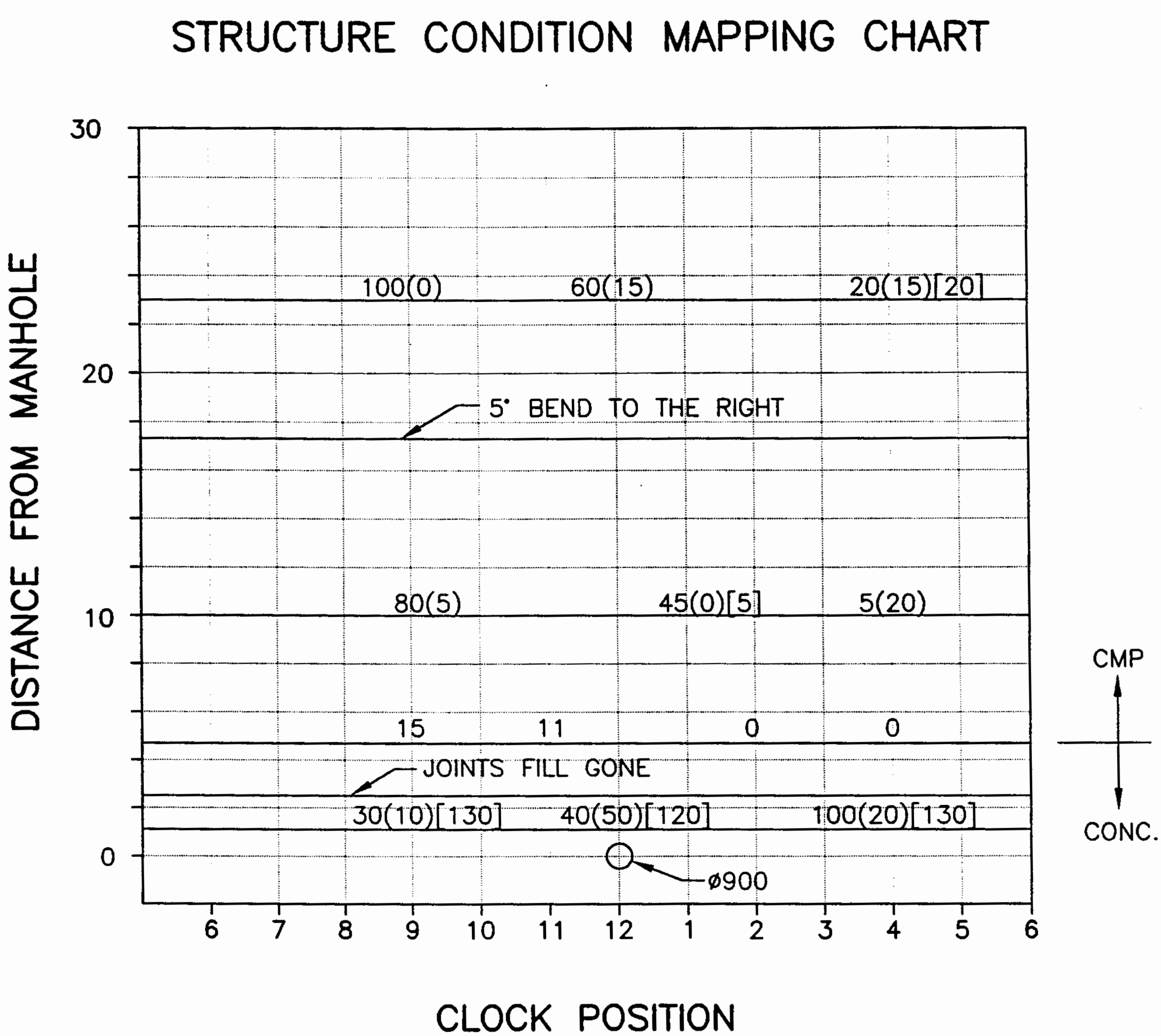


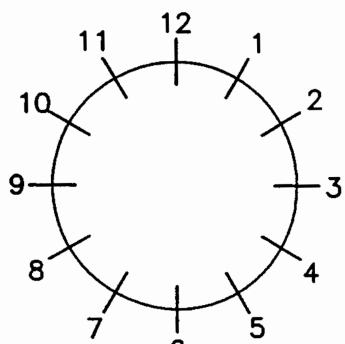
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	BU1	

KGS FILE NO.: 97-107-12BU1





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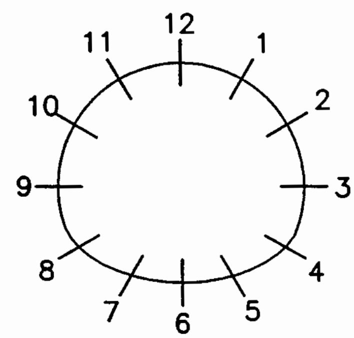


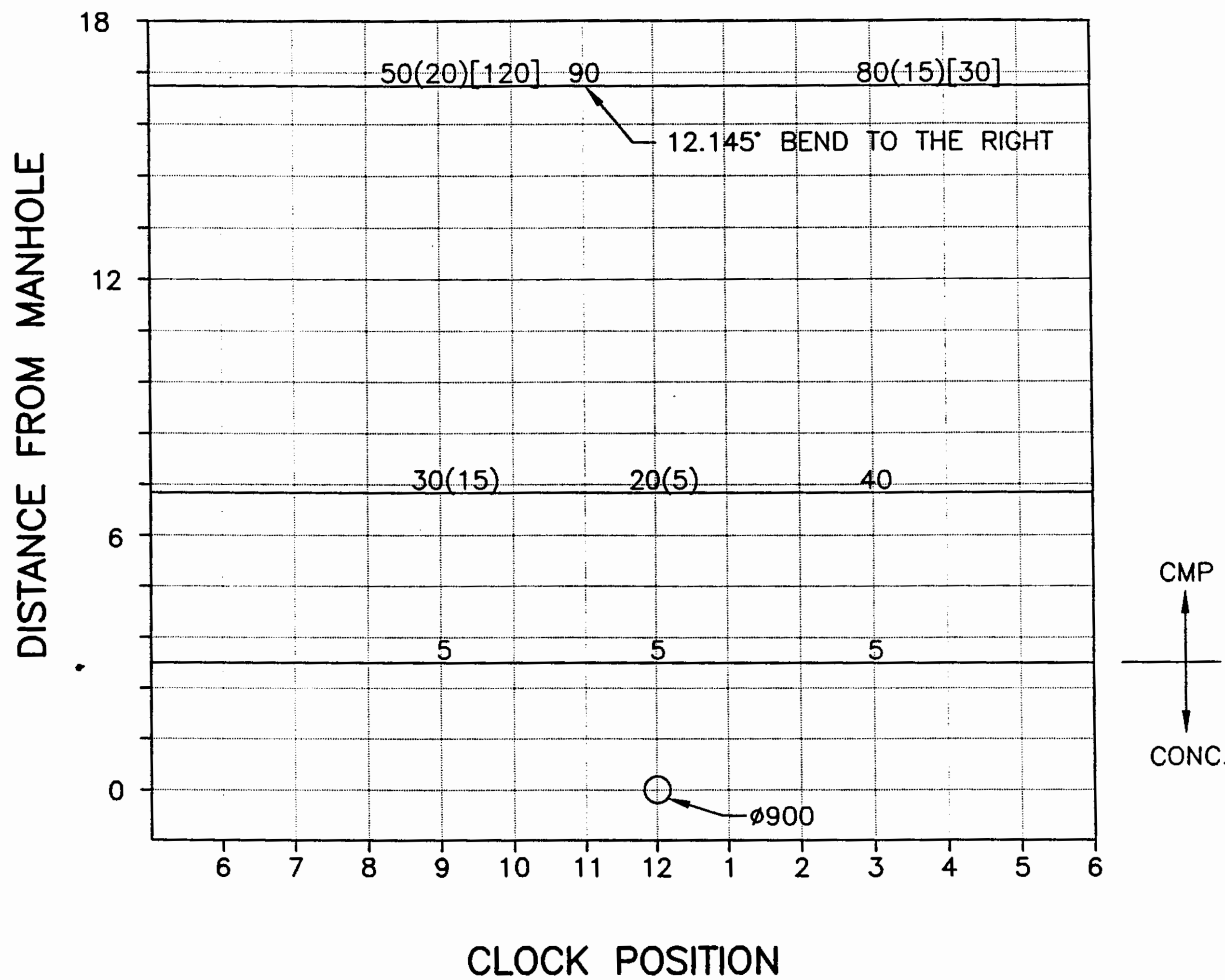
Clock Reference Looking
DOWNSTREAM

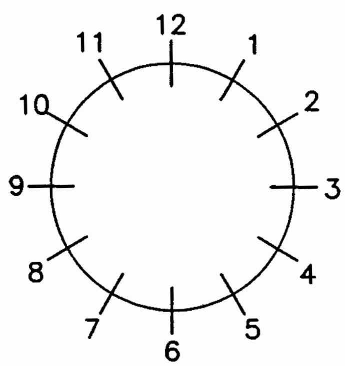
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	BU2	

KGS FILE NO.: 97-107-12BU2

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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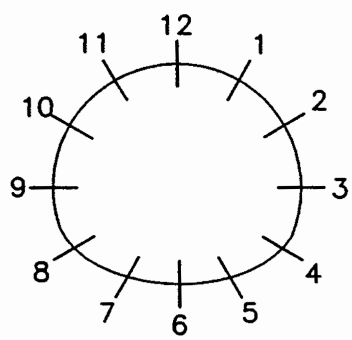


Clock Reference Looking
DOWNSTREAM

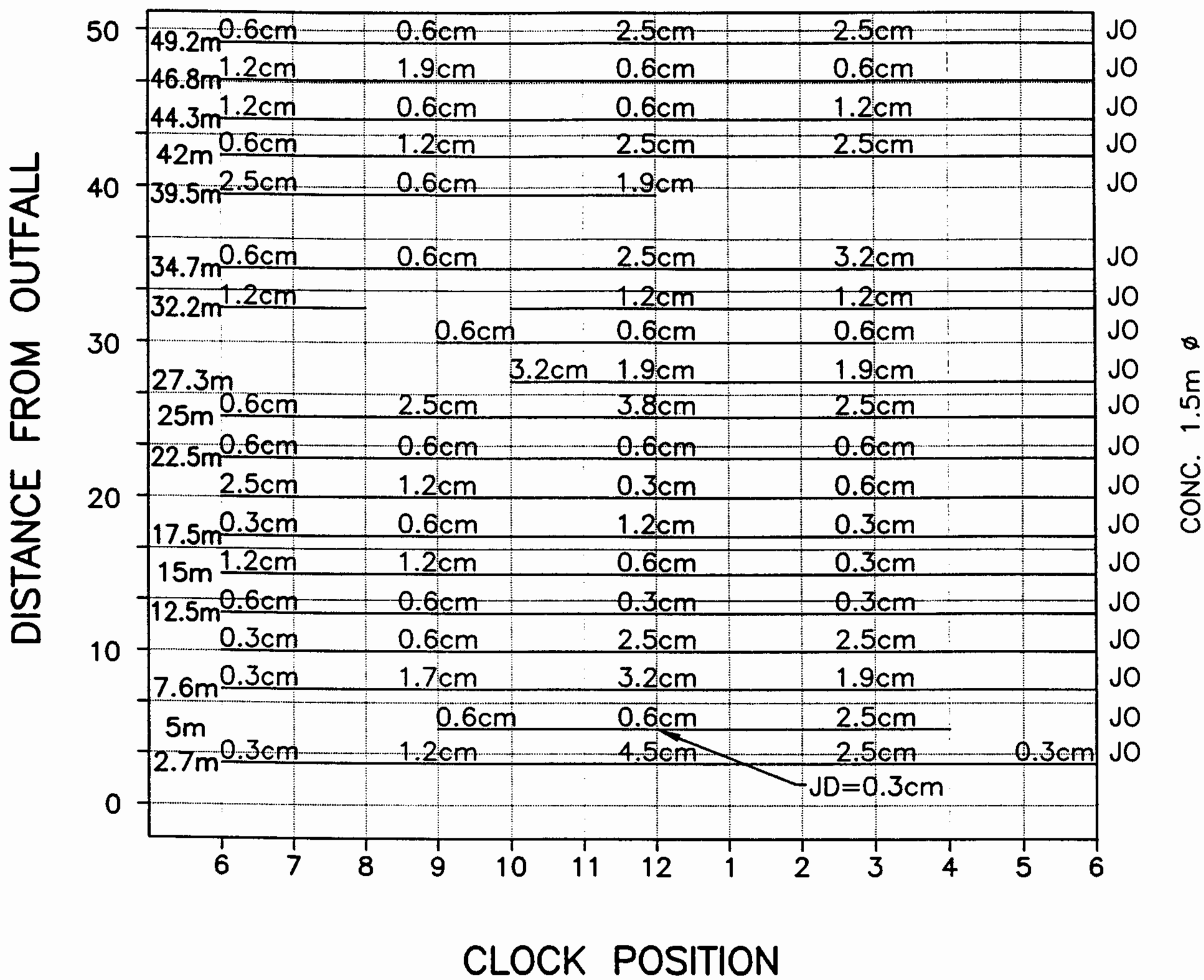
LEGEND:

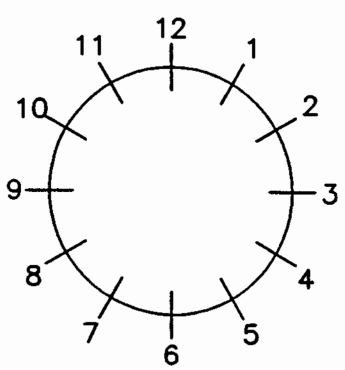
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	BU10	

WINNIPEG FLOODWAY

PROPERTY
OF THE
WATER & WASTE DEPARTMENT
RESOURCE CENTRE
1500 PLESSIS ROAD

STRUCTURE CONDITION MAPPING CHART





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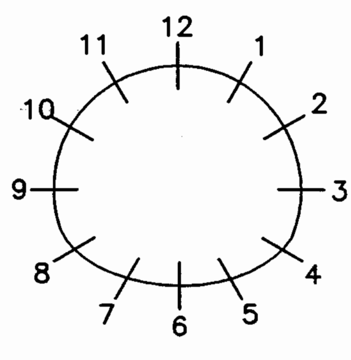


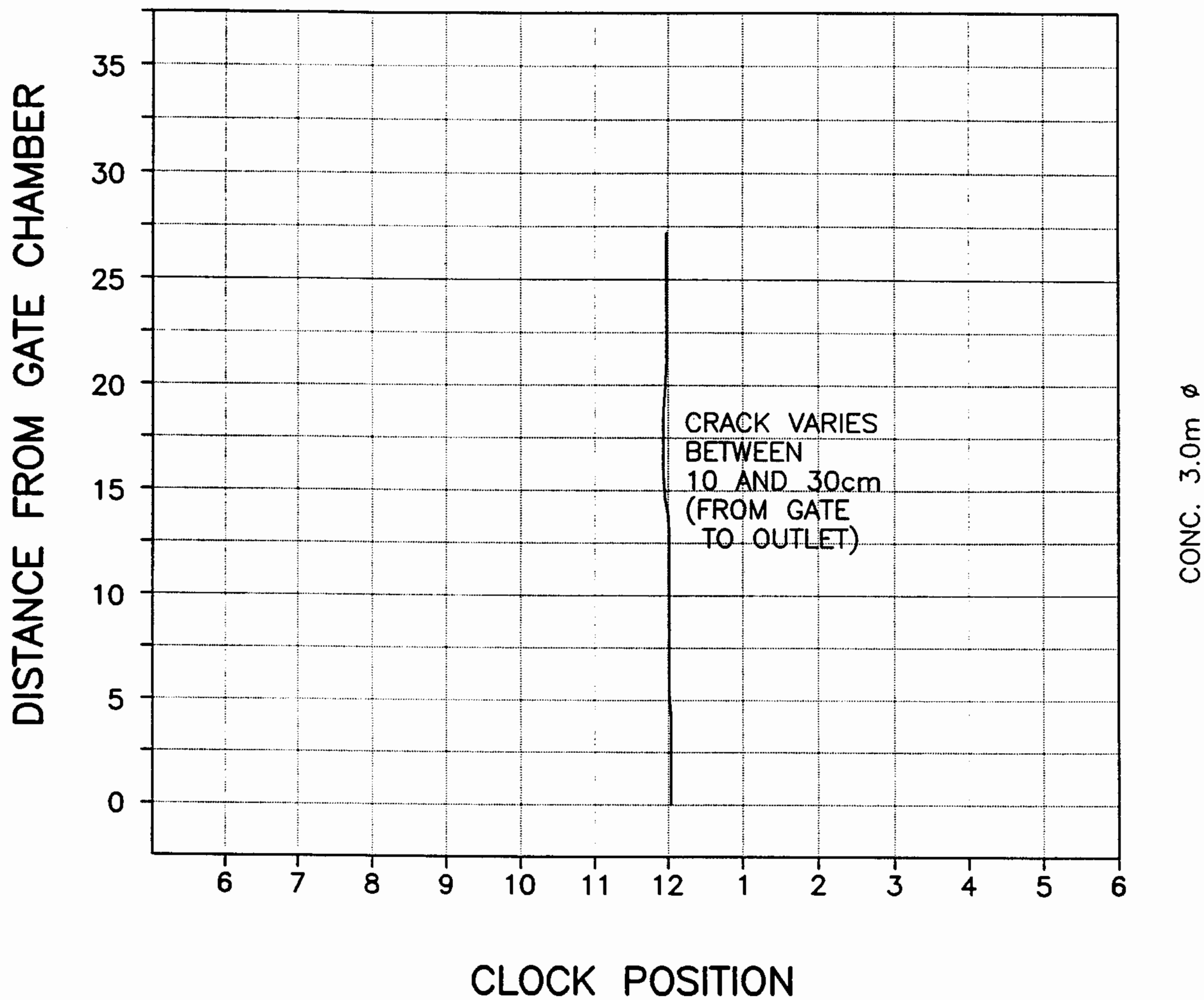
Clock Reference Looking
DOWNSTREAM

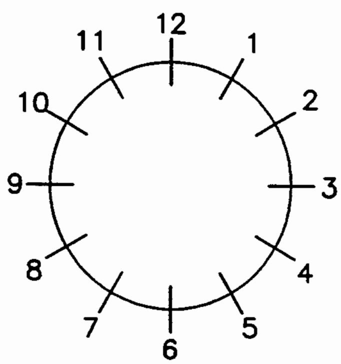
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	FL1	

KGS FILE NO.: 97-107-12FL1

STRUCTURE CONDITION MAPPING CHART





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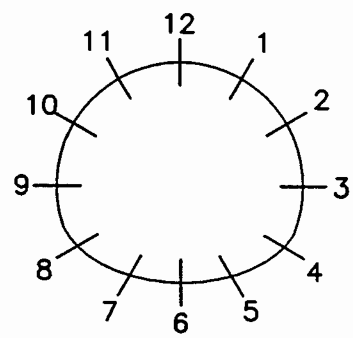
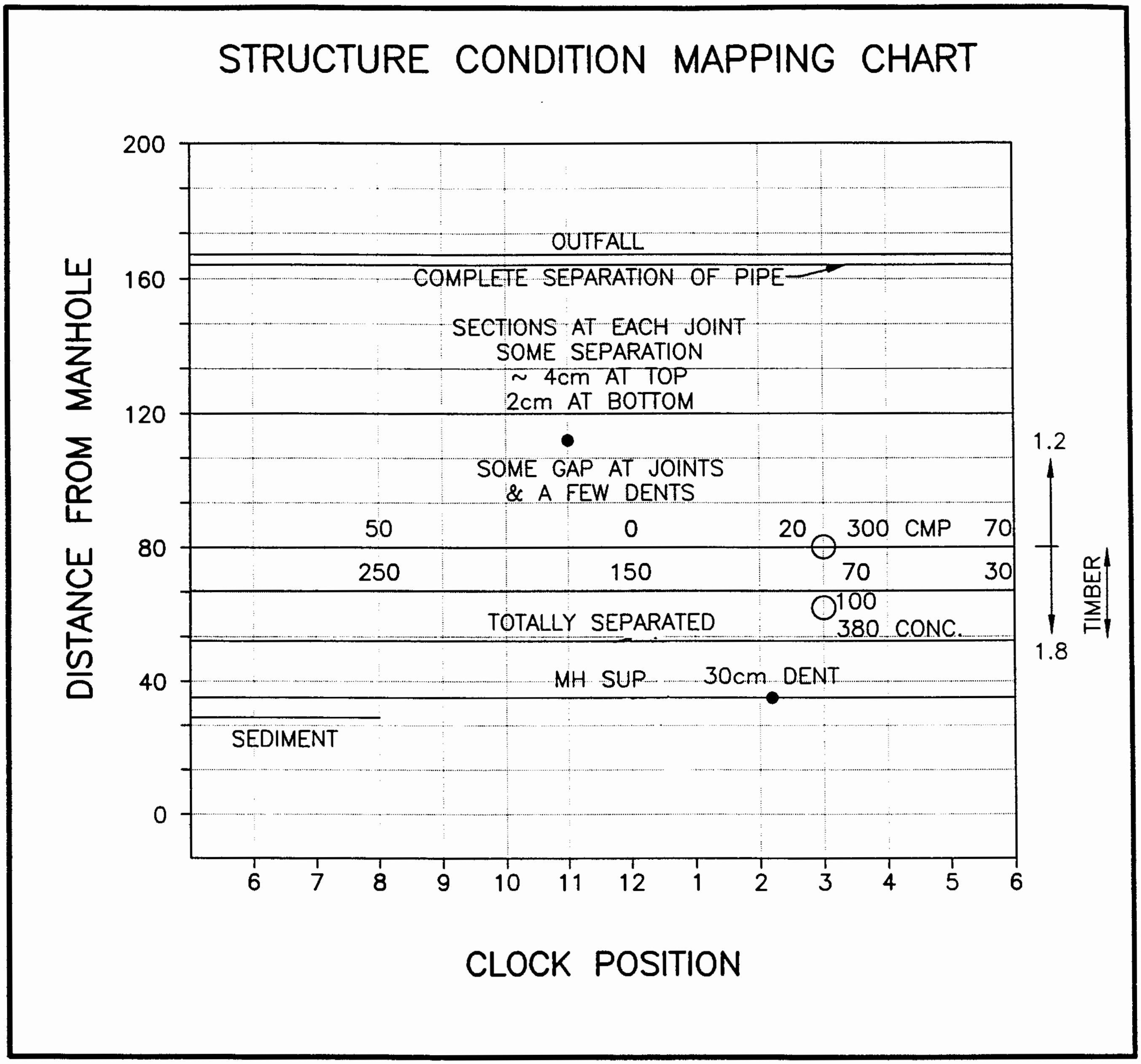


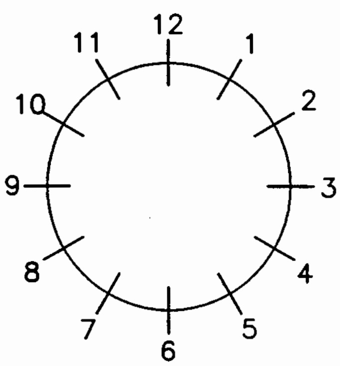
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	FL2	

KGS FILE NO.: 97-107-12FL2





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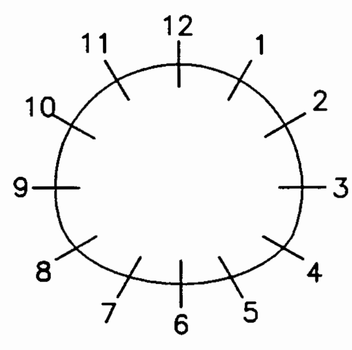


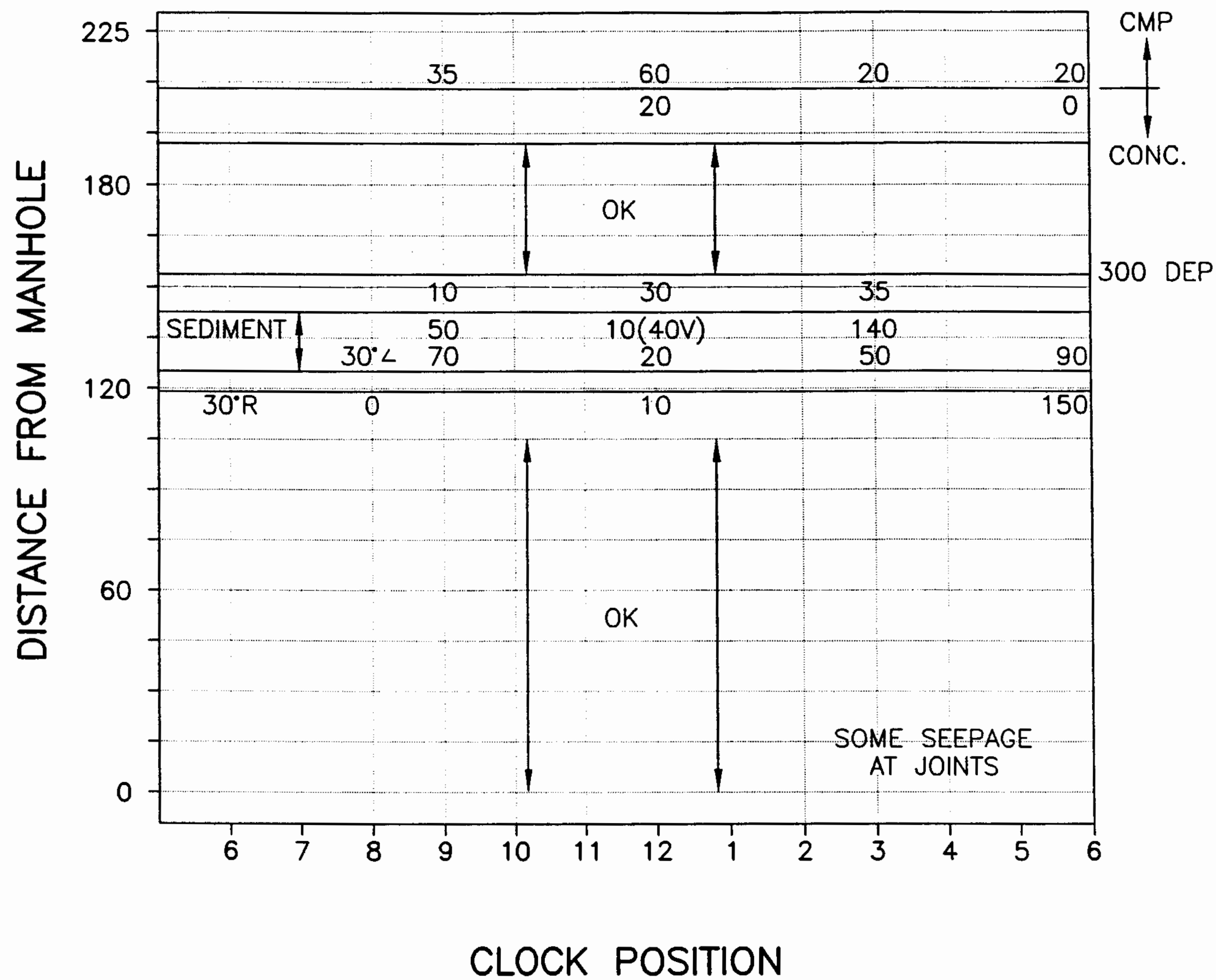
Clock Reference Looking
DOWNSTREAM

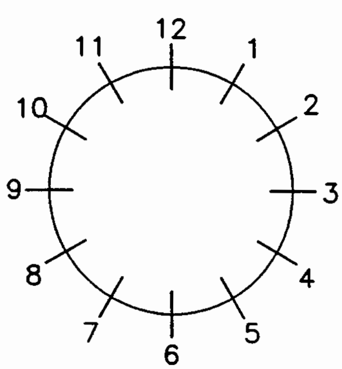
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R7	

KGS FILE NO.: 97-107-12R7

STRUCTURE CONDITION MAPPING CHART





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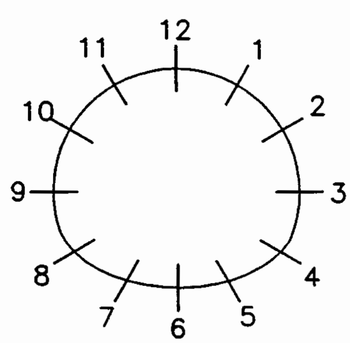
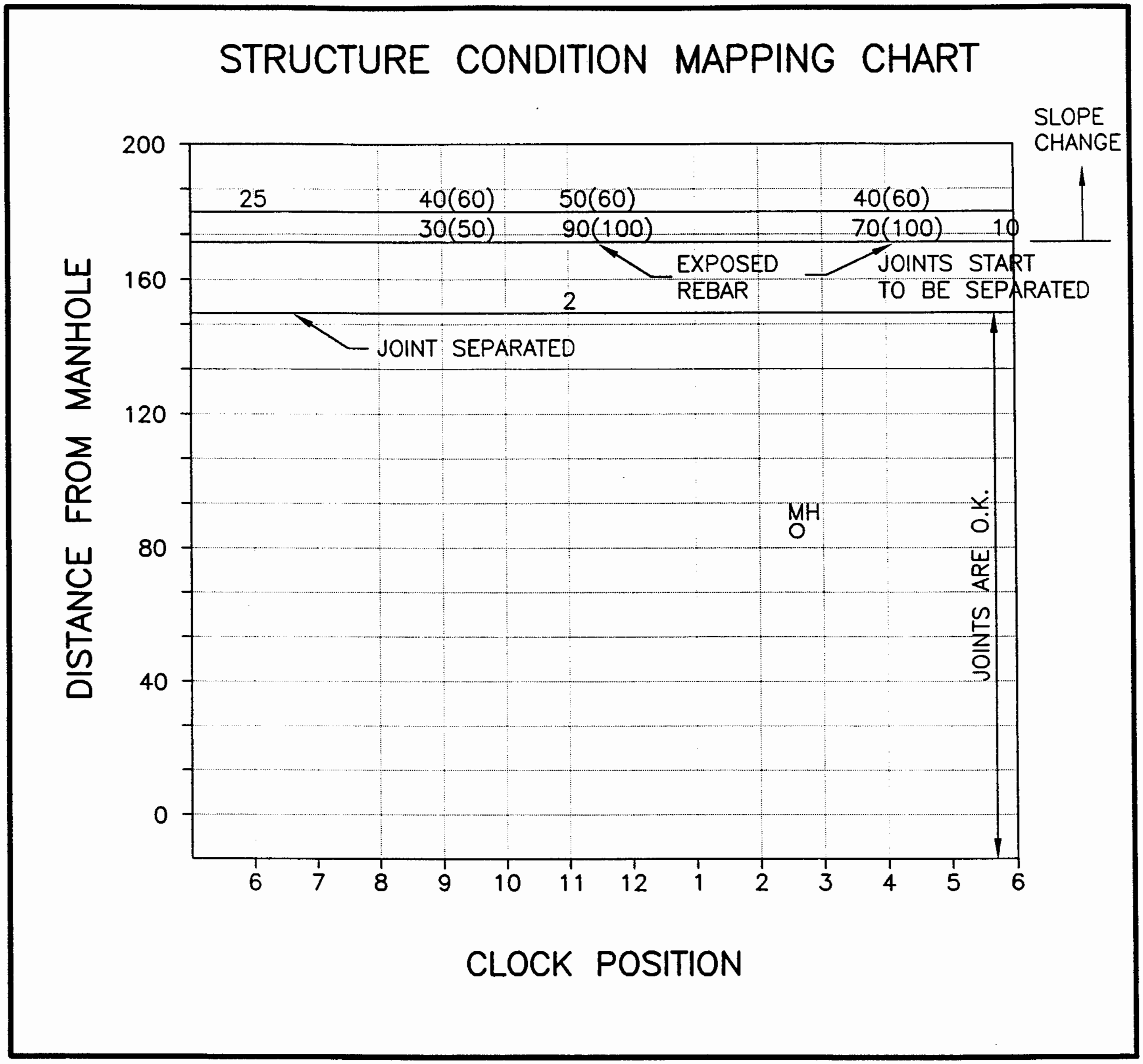


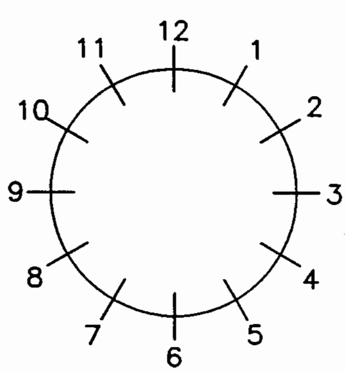
Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R9	

KGS FILE NO.: 97-107-12R9





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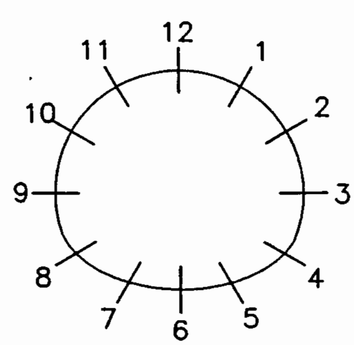


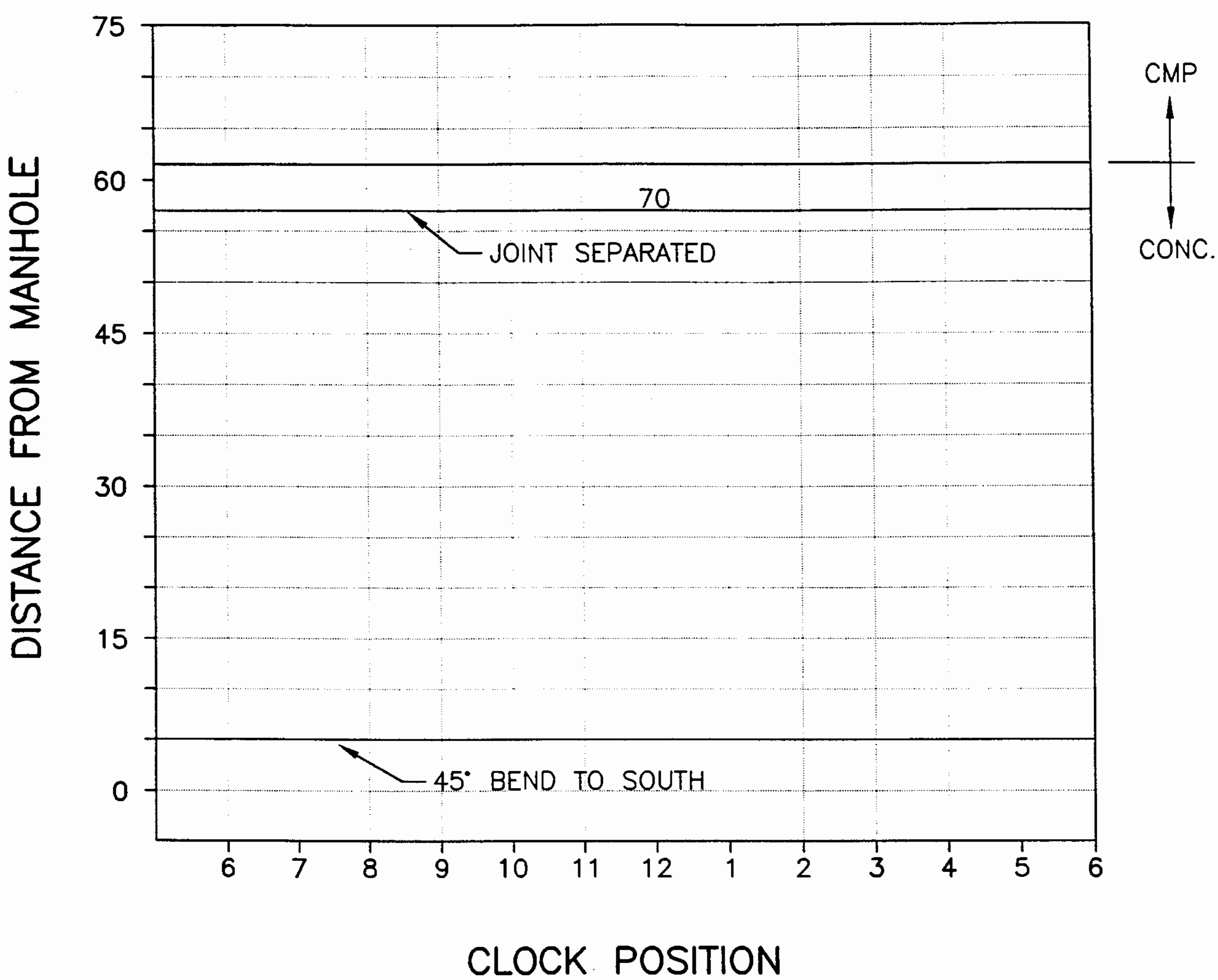
Clock Reference Looking DOWNSTREAM

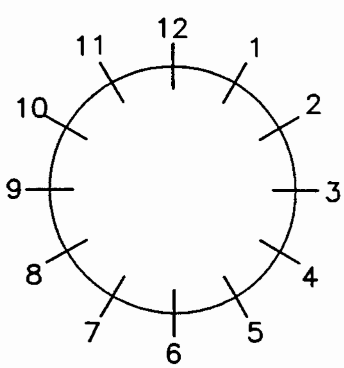
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R10	

KGS FILE NO.: 97-107-12R10

STRUCTURE CONDITION MAPPING CHART





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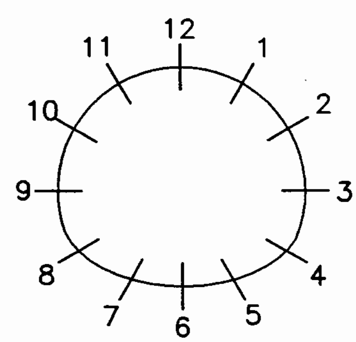


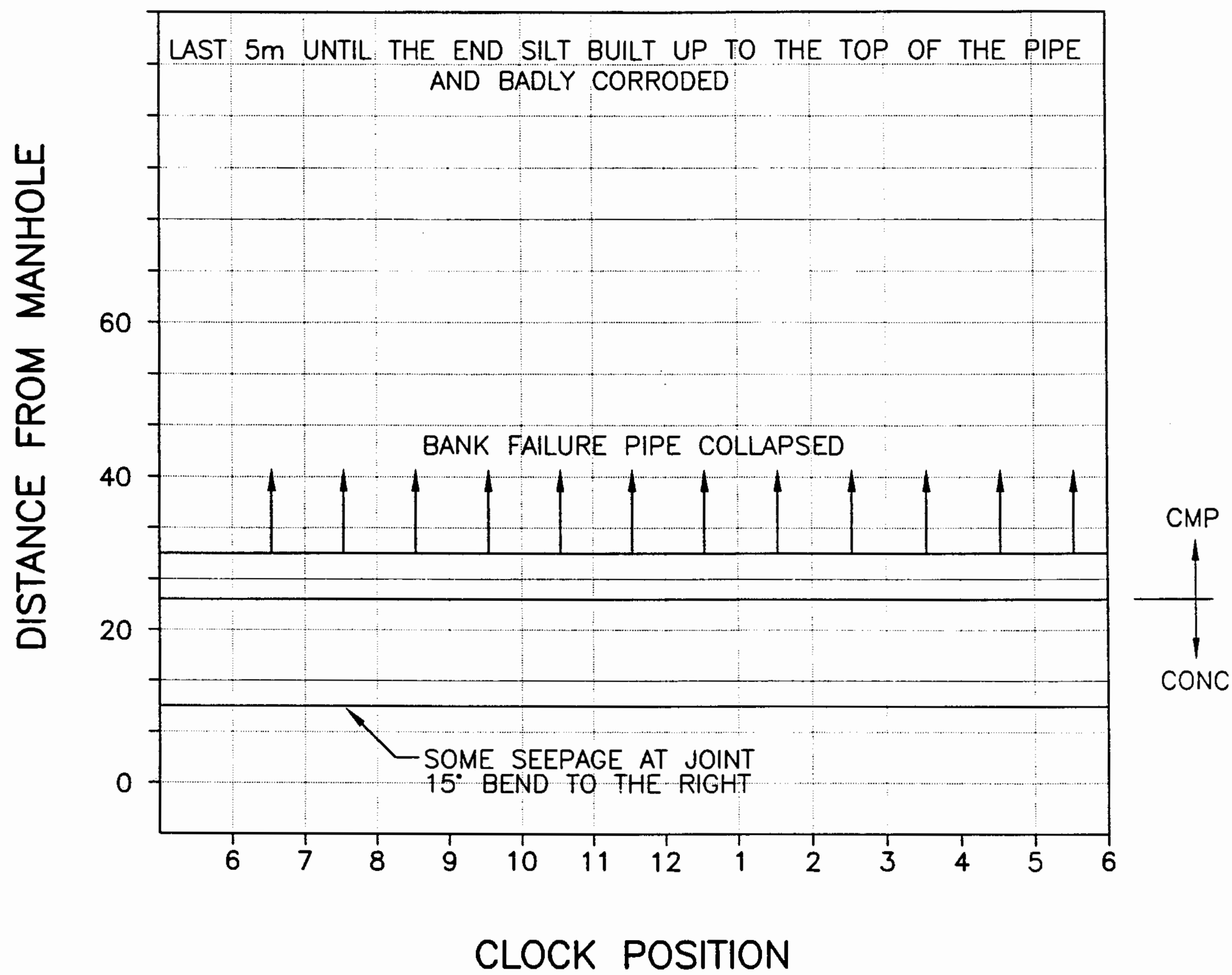
Clock Reference Looking
DOWNSTREAM

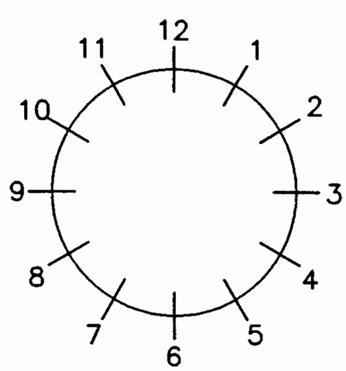
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R12	

KCS FILE NO.: 97-107-12R12

STRUCTURE CONDITION MAPPING CHART





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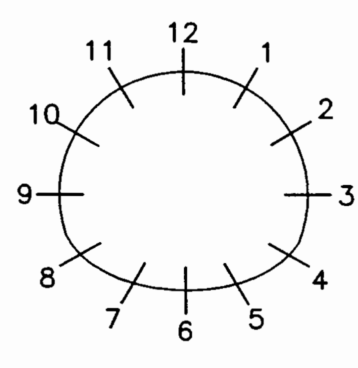


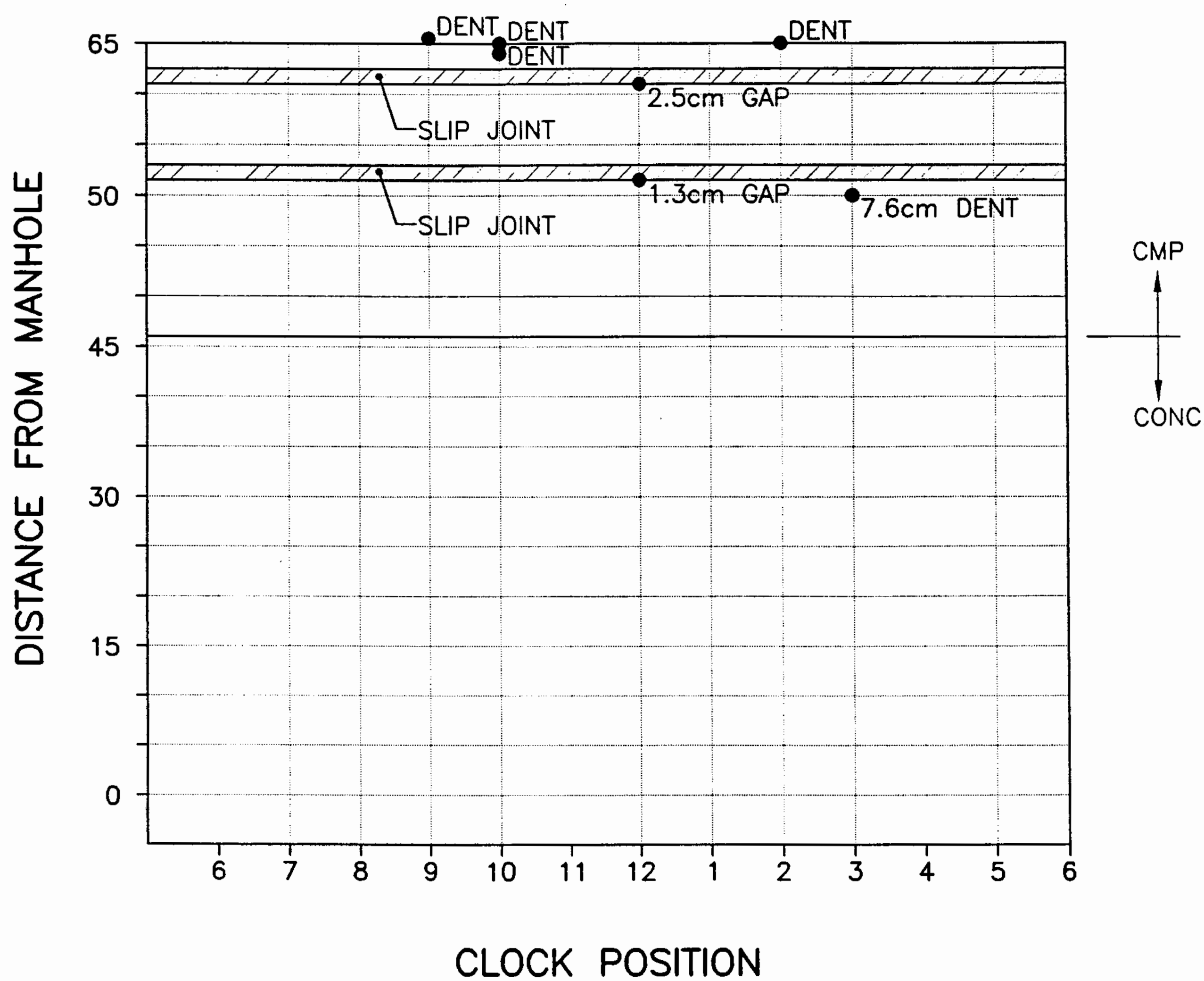
Clock Reference Looking DOWNSTREAM

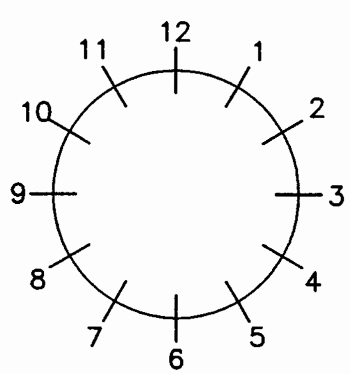
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R15	

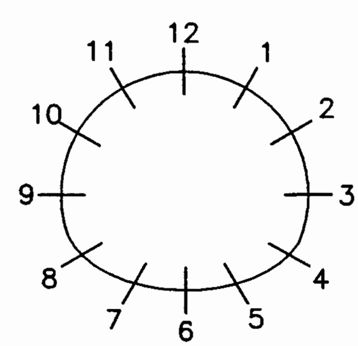
KGS FILE NO.: 97-107-12R15

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



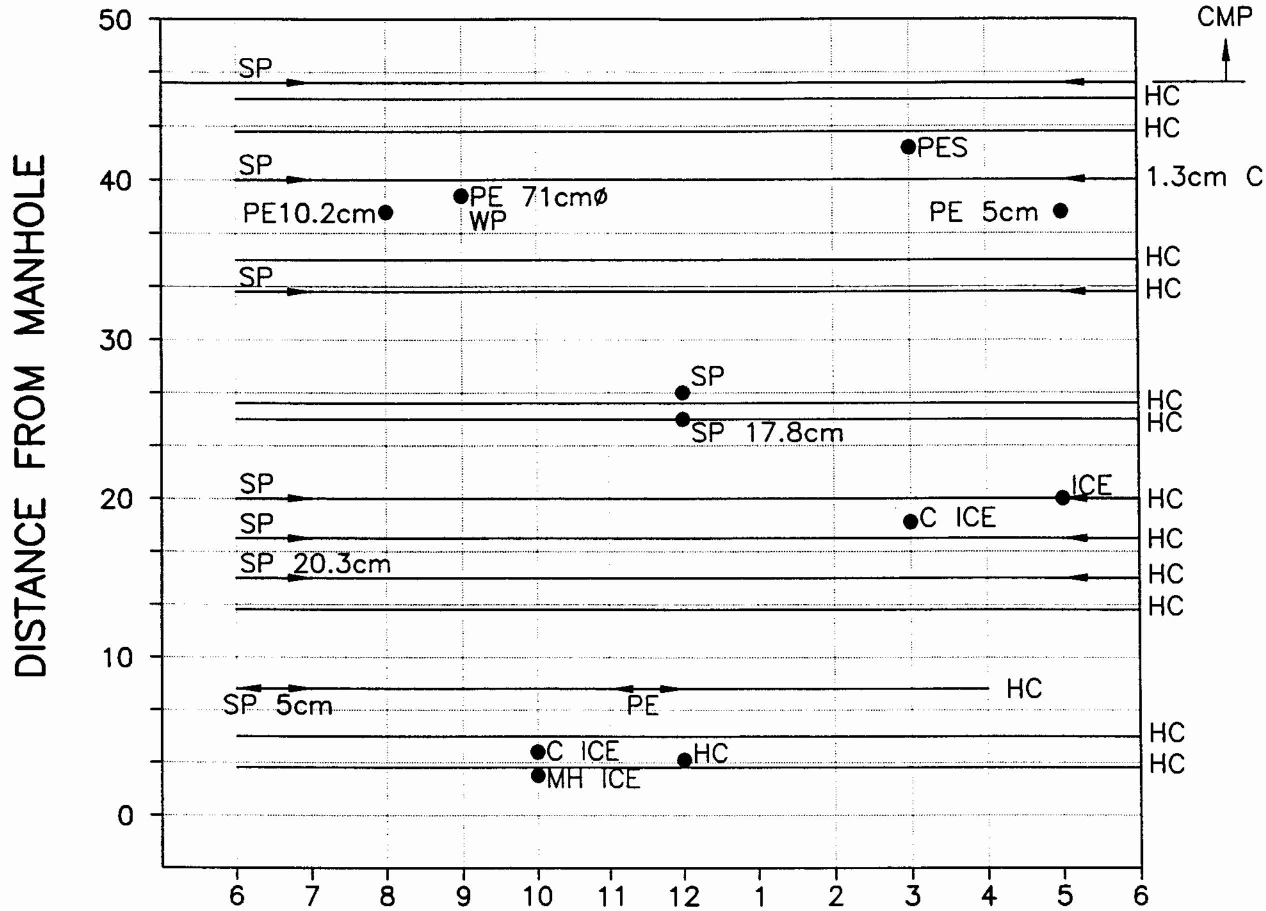
Clock Reference Looking DOWNSTREAM

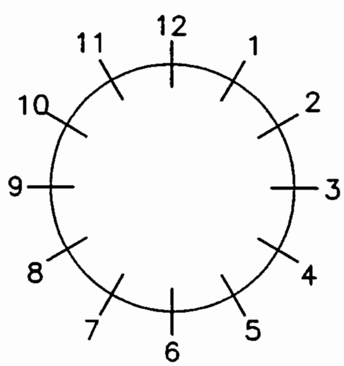
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R17A	

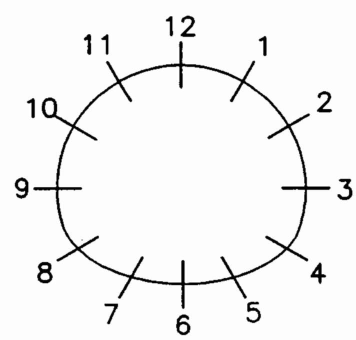
KGS FILE NO.: 97-107-12R17

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



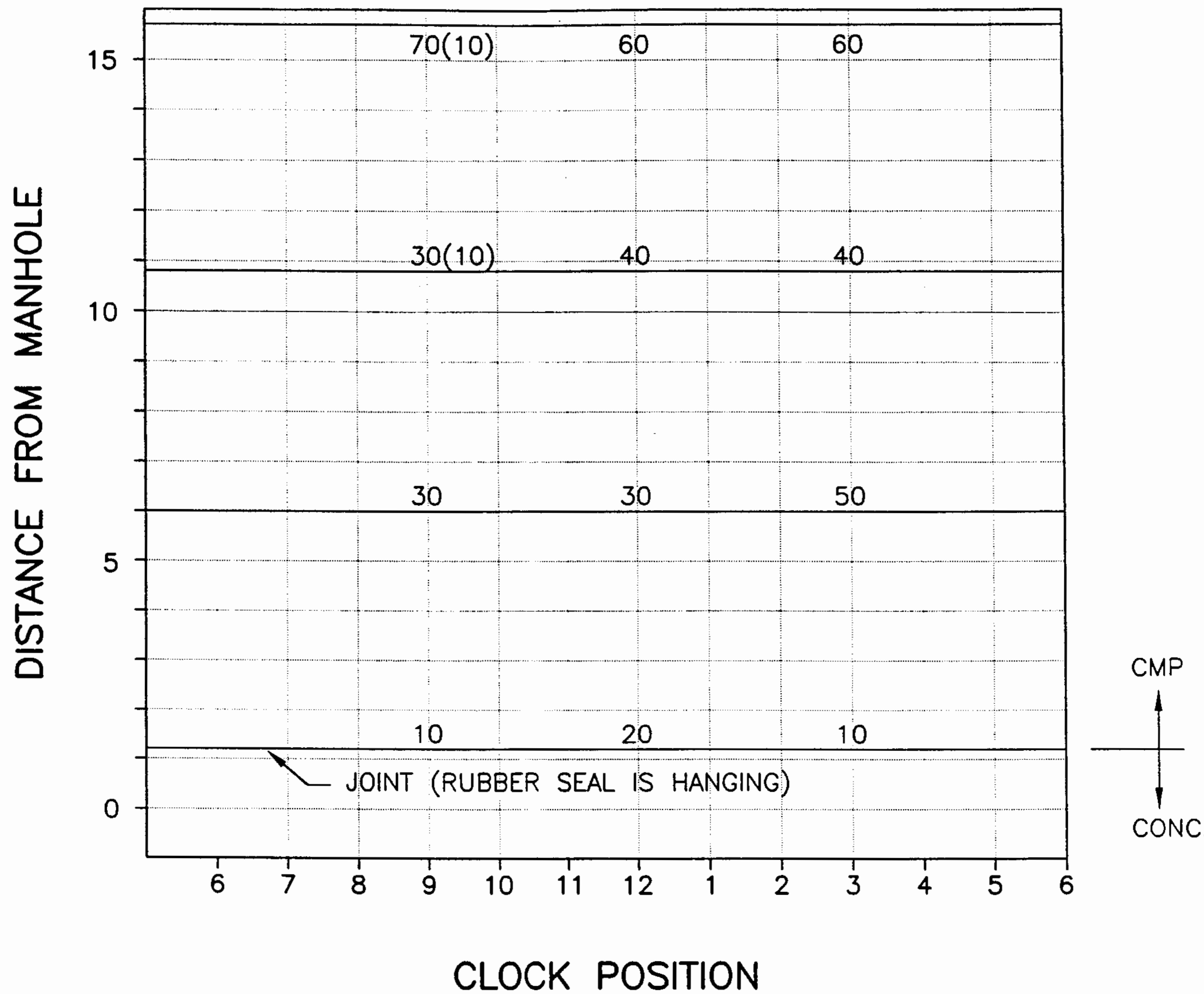
Clock Reference Looking DOWNSTREAM

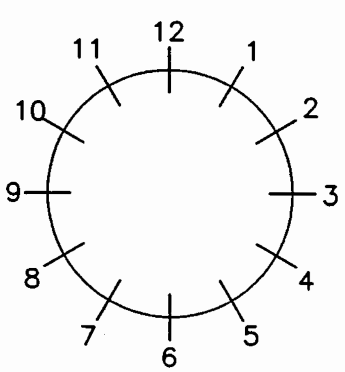
LEGEND:

DEFECTIVE CONCRETE:		Spalling	SP	JOINTS:	Spalled	SP
Water Seepage	WP	Cracked	C		Displaced	JD
Manhole	MH	Pipe Entrance	PE		Spalled	SP
Seepage	S	Pipe Entrance Sealed	PES	PIPE IDENTIFICATION:	R17B	

KGS FILE NO.: 97-107-12R17

STRUCTURE CONDITION MAPPING CHART





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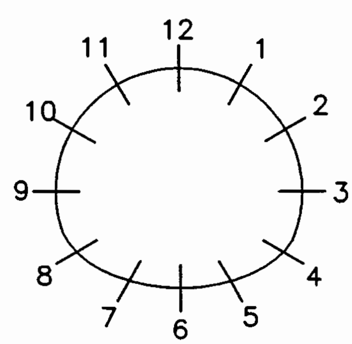
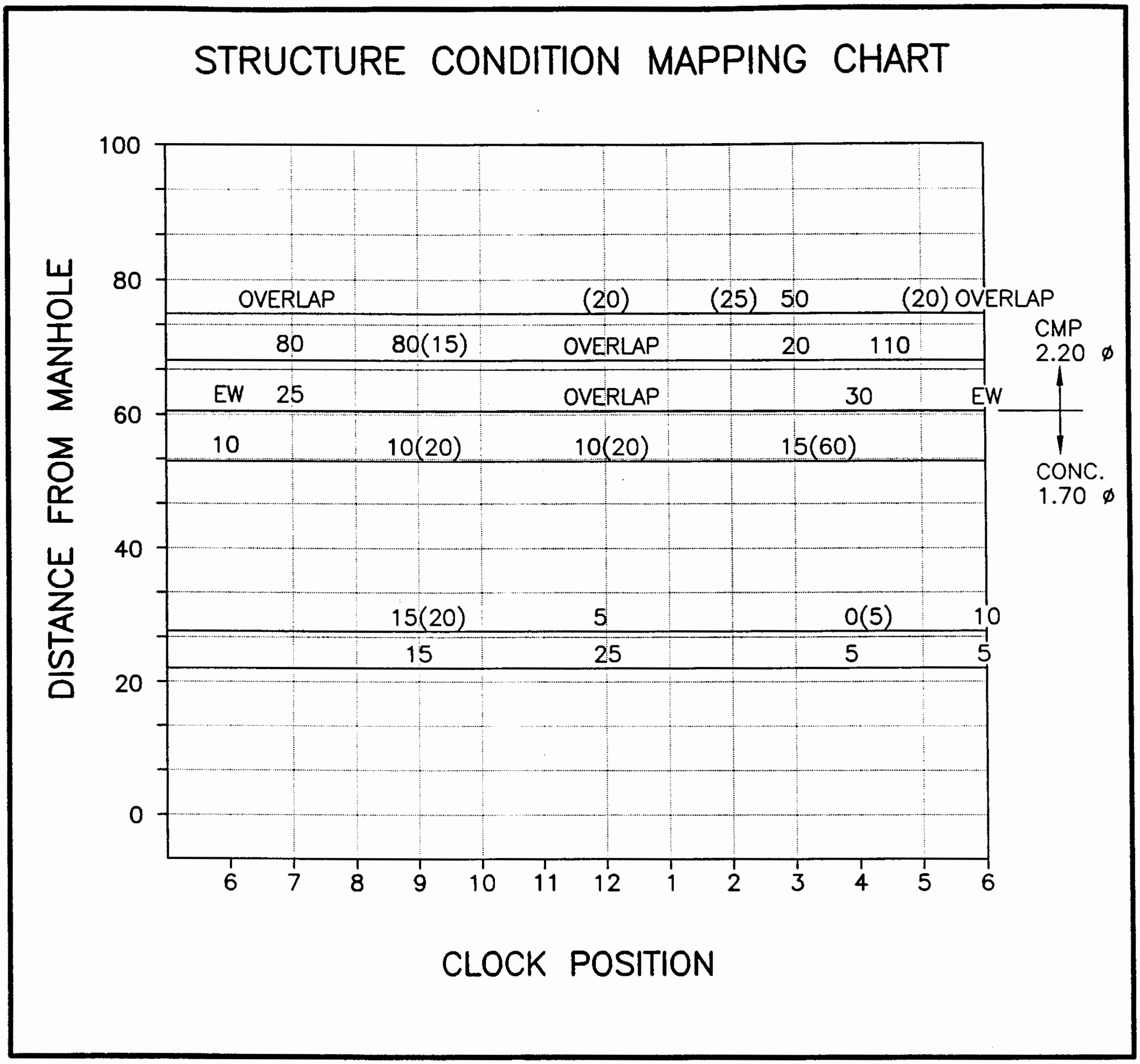


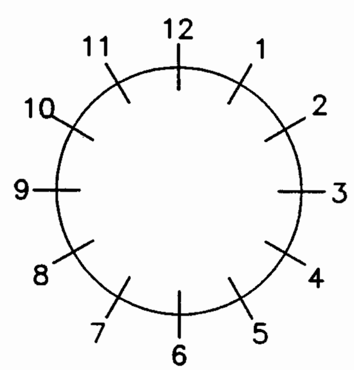
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R19	

KGS FILE NO.: 97-107-12R19





Clock Reference Looking
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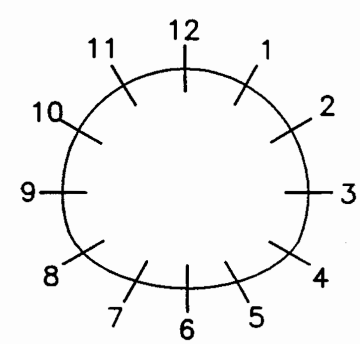


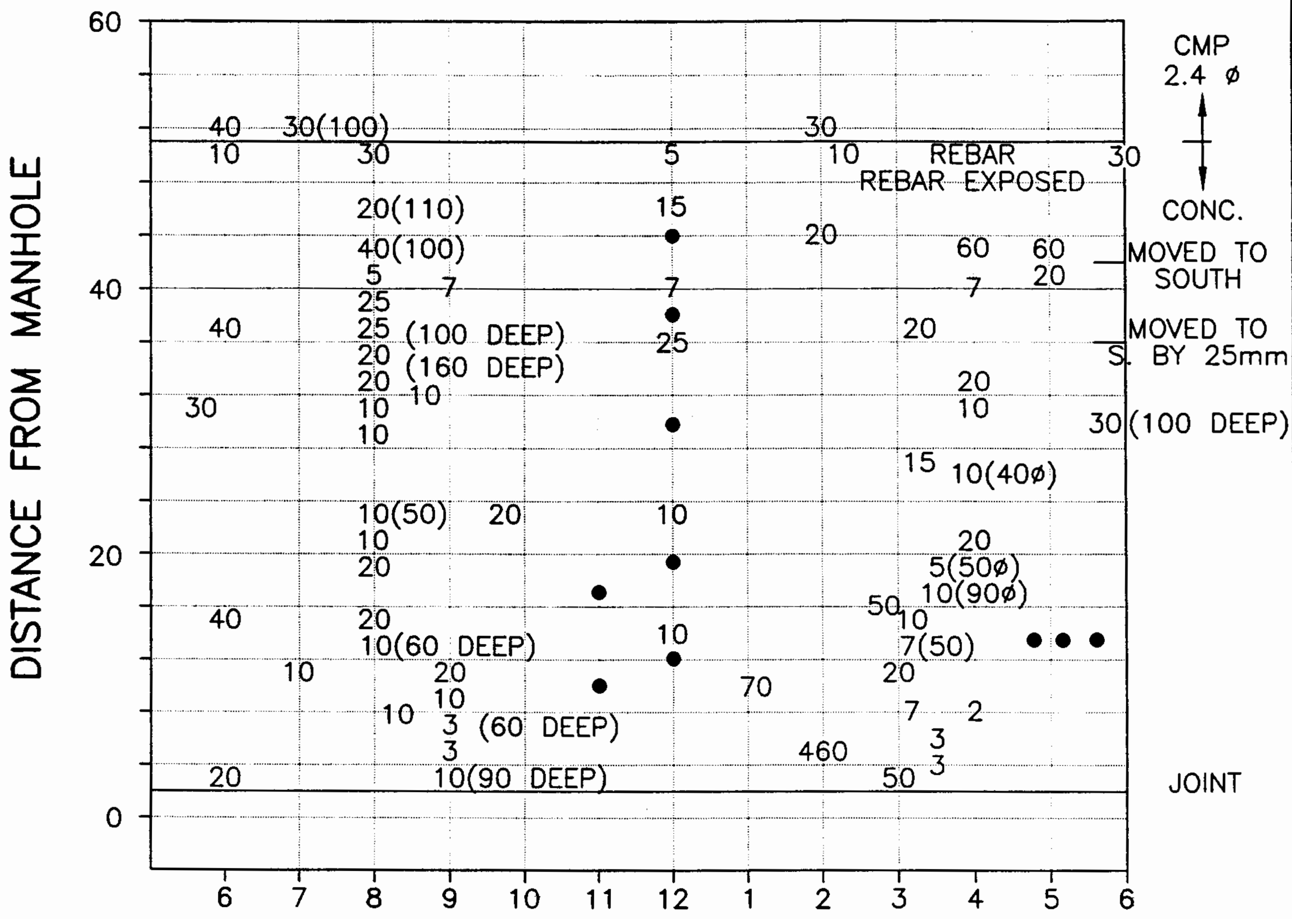
Clock Reference Looking
DOWNSTREAM

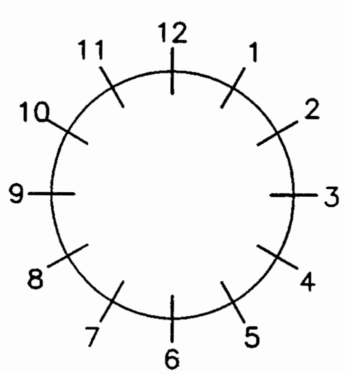
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R20	

KCS FILE NO.: 97-107-12R20

STRUCTURE CONDITION MAPPING CHART





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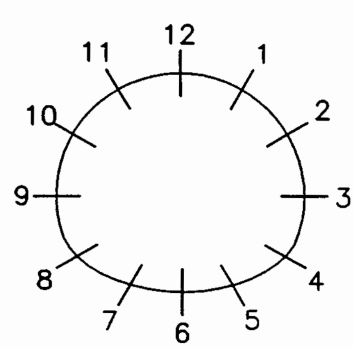


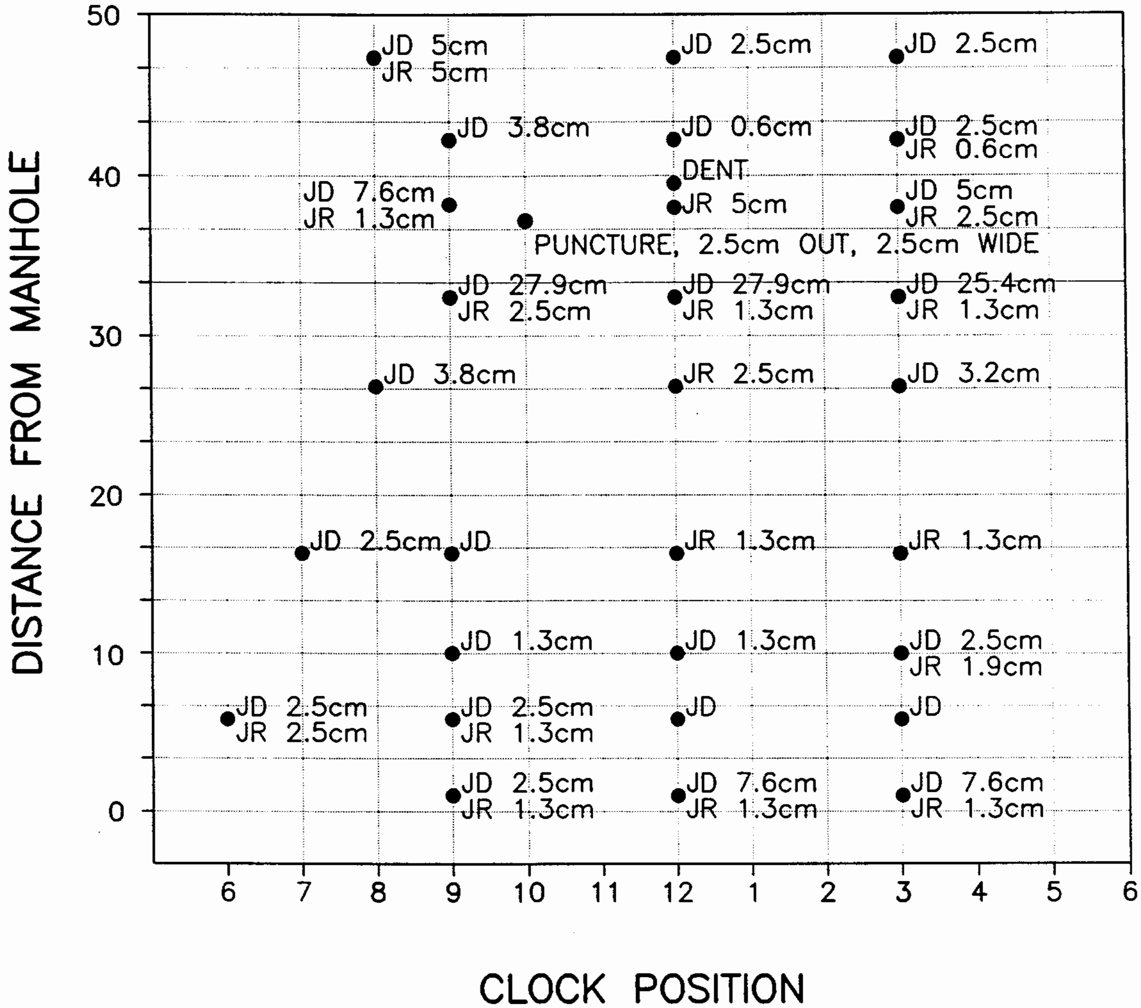
Clock Reference Looking DOWNSTREAM

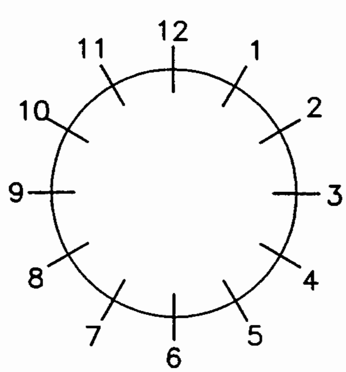
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R22	

KGS FILE NO.: 97-107-12R22

STRUCTURE CONDITION MAPPING CHART





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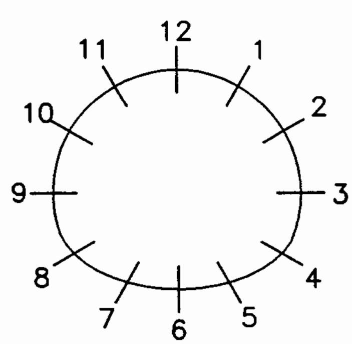
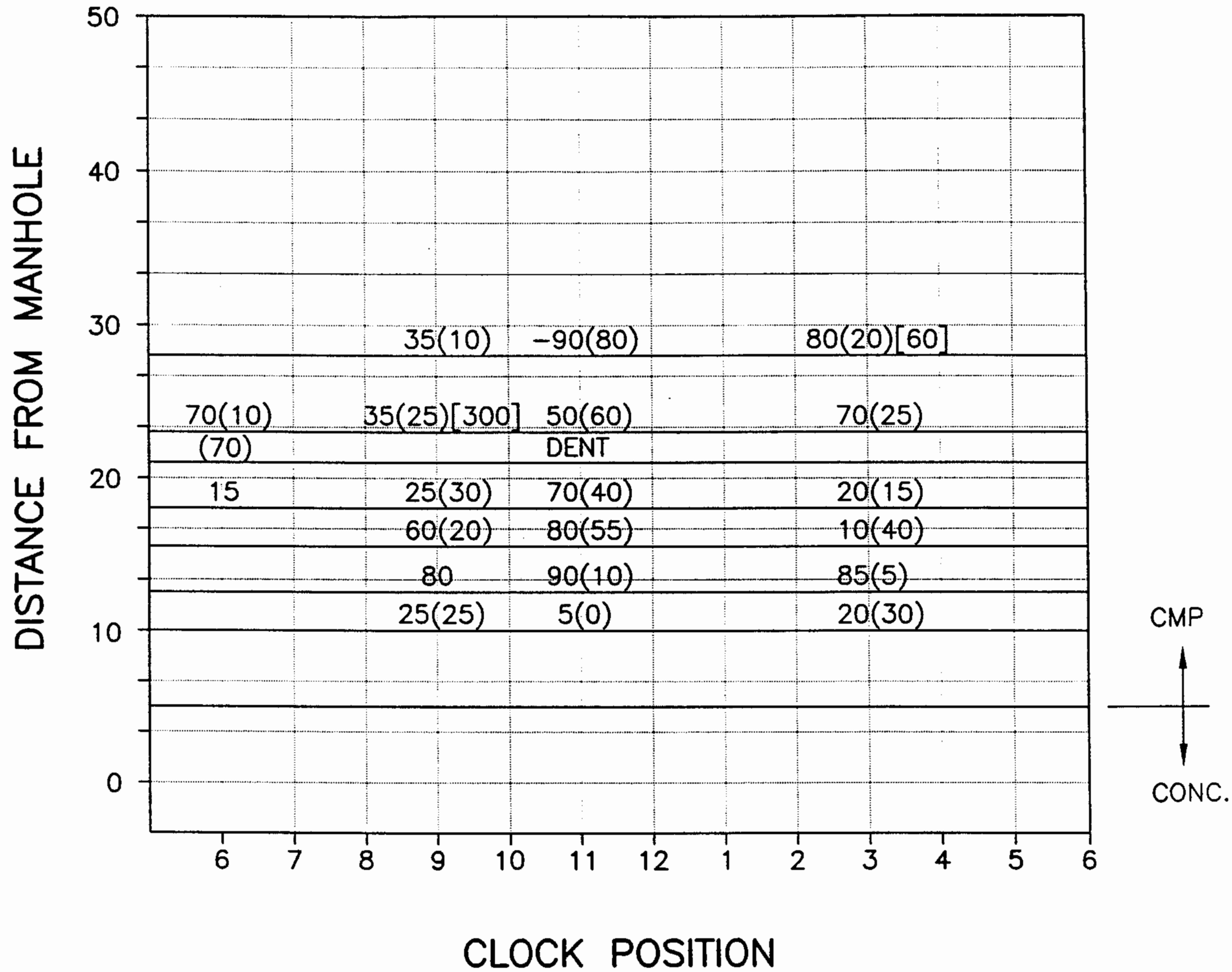


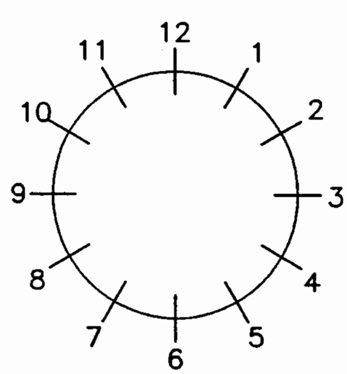
Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R25	

STRUCTURE CONDITION MAPPING CHART





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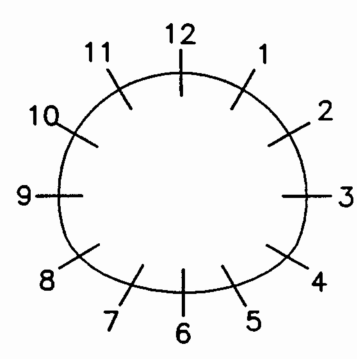
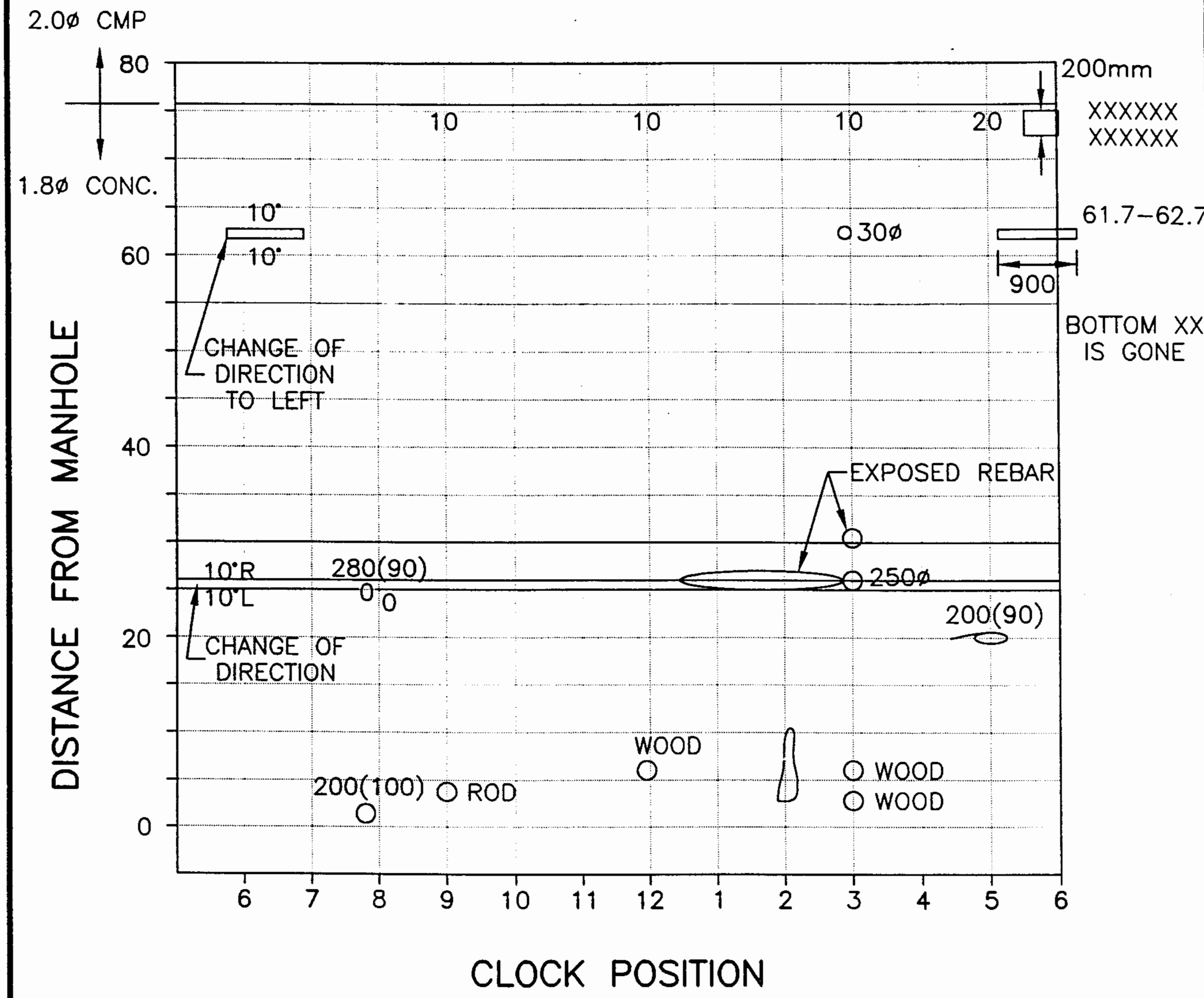


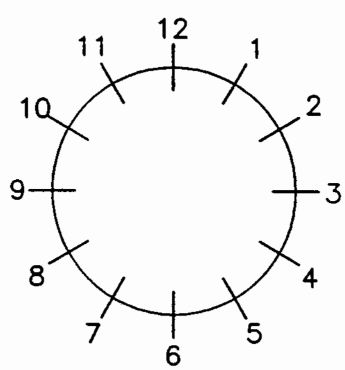
Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R31	

STRUCTURE CONDITION MAPPING CHART





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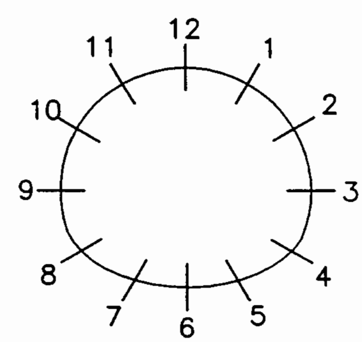


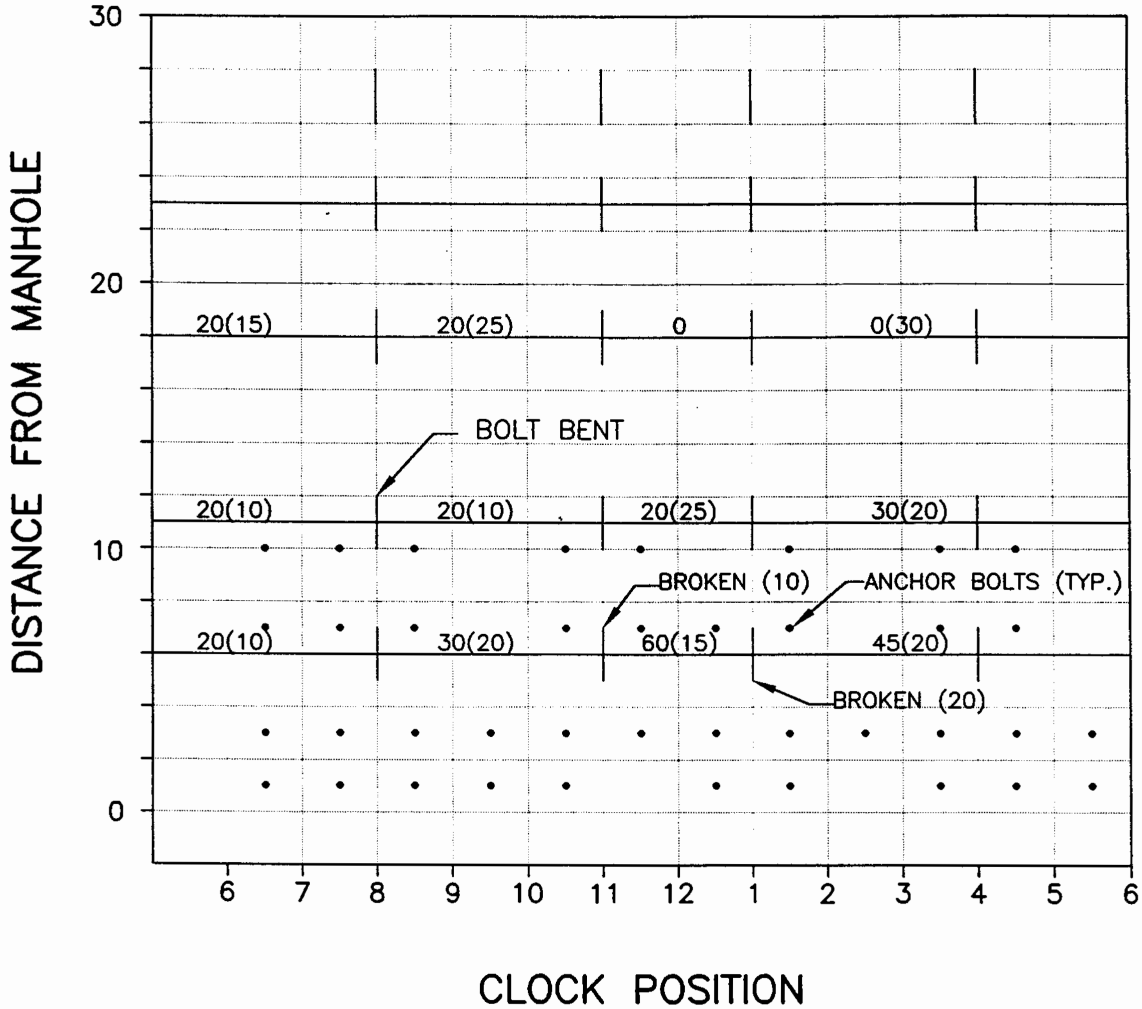
Clock Reference Looking
DOWNSTREAM

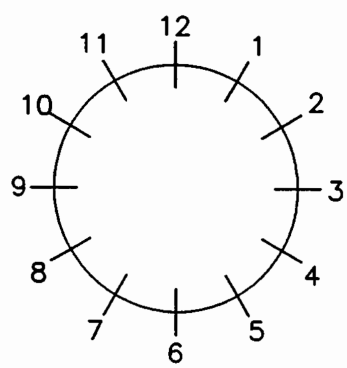
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R36	

KGS FILE NO.: 97-107-1234

STRUCTURE CONDITION MAPPING CHART





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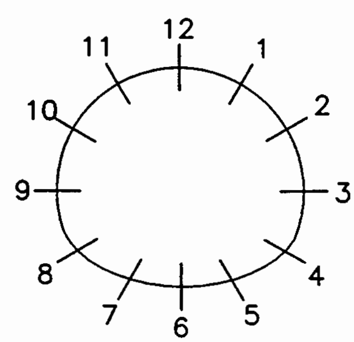


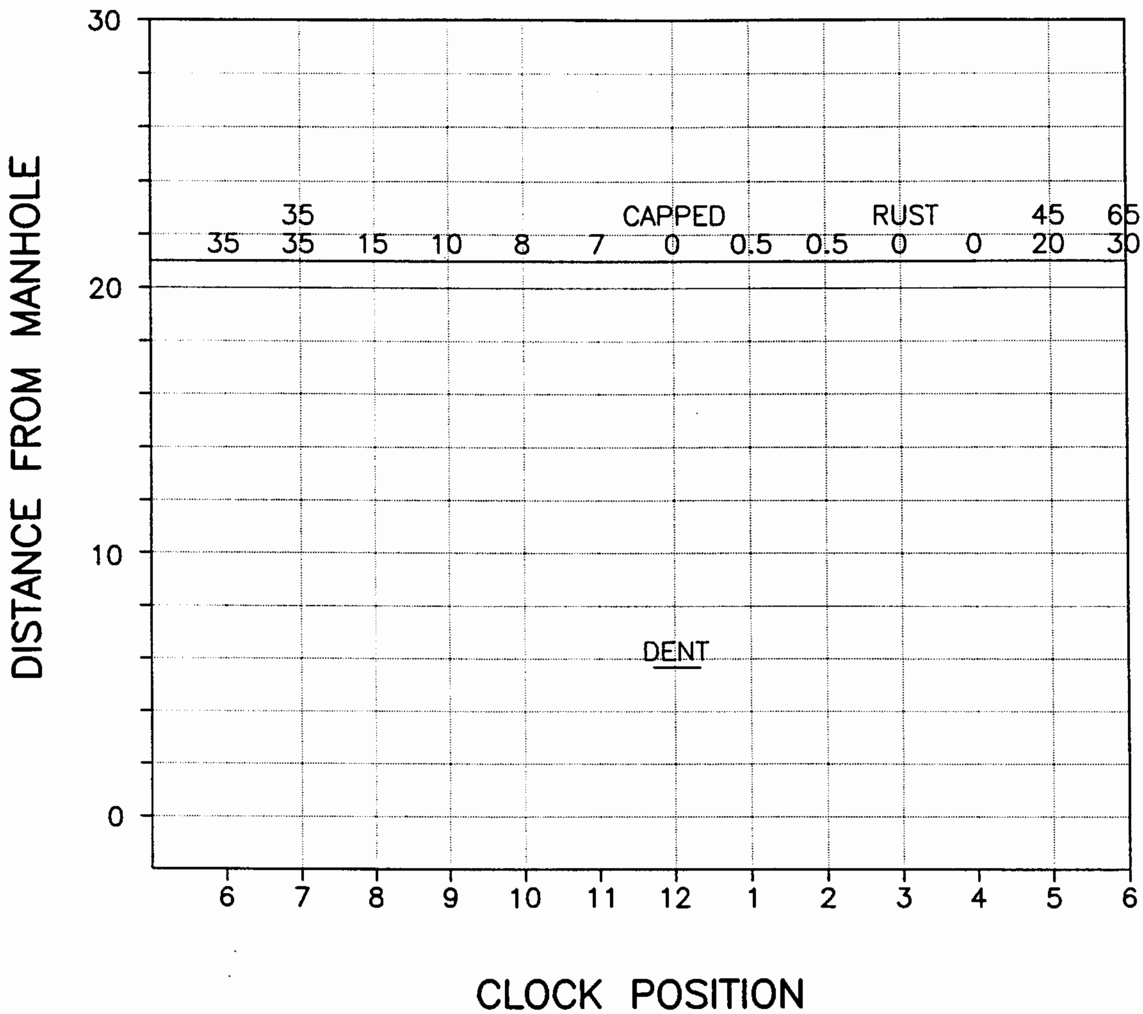
Clock Reference Looking DOWNSTREAM

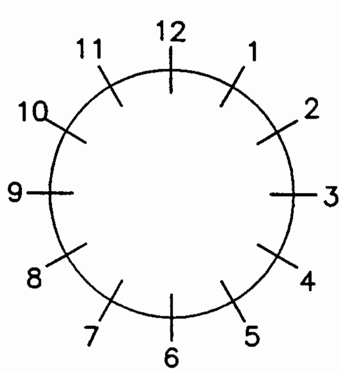
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
• ANCHOR BOLT	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R38	

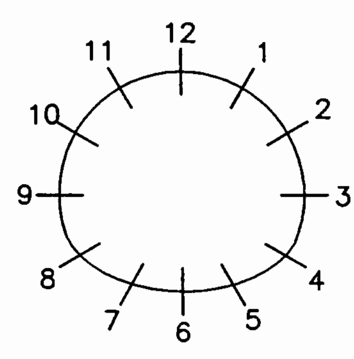
KGS FILE NO.: 97-107-12R38

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



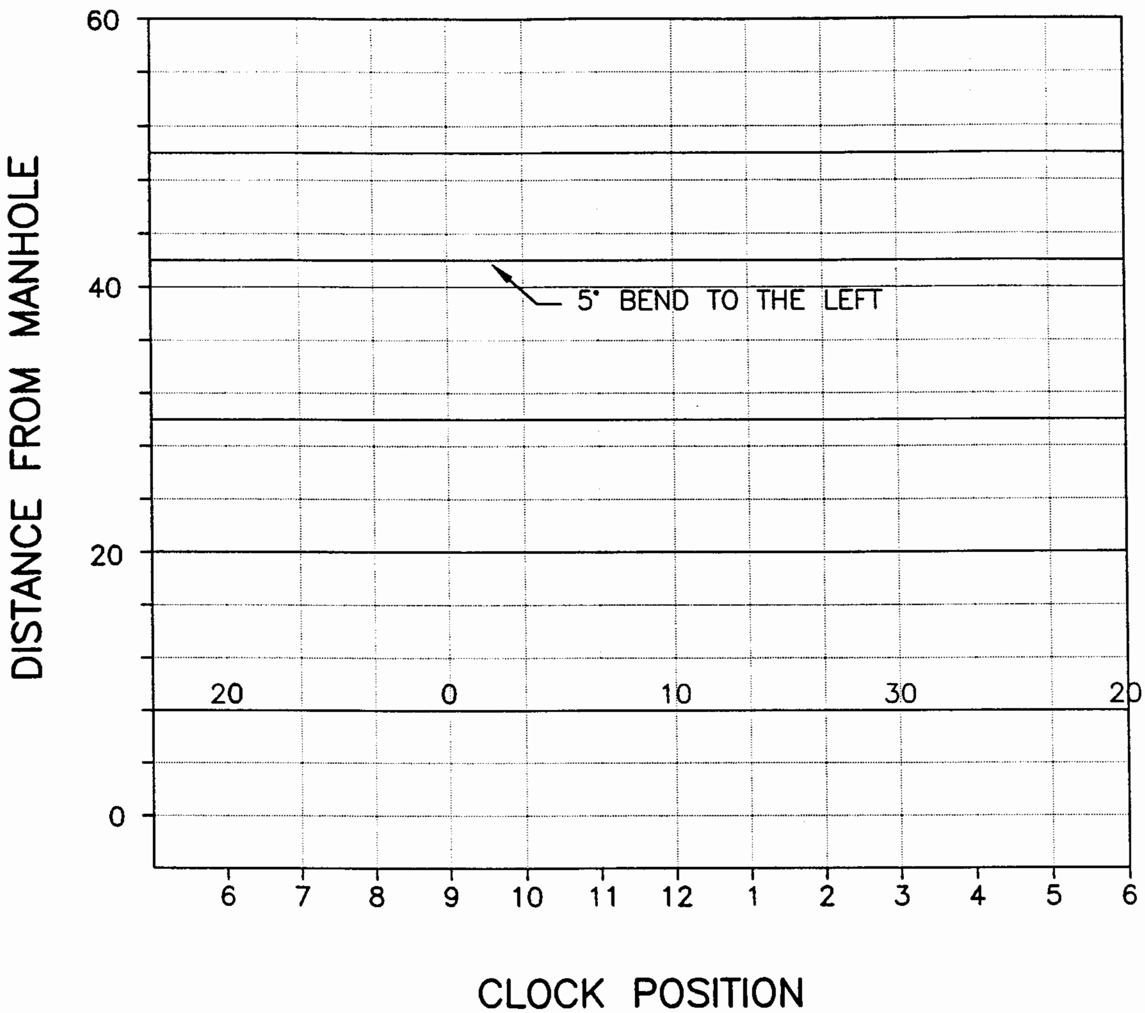
Clock Reference Looking
DOWNSTREAM

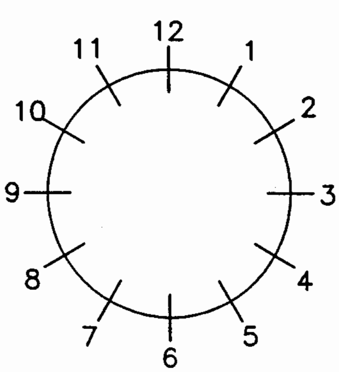
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R39	

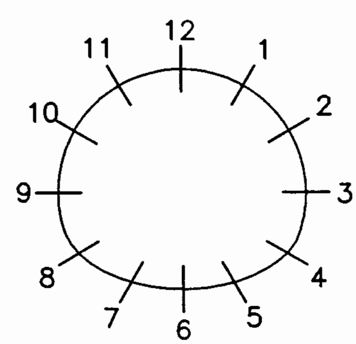
KGS FILE NO.: 97-107-12R39

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



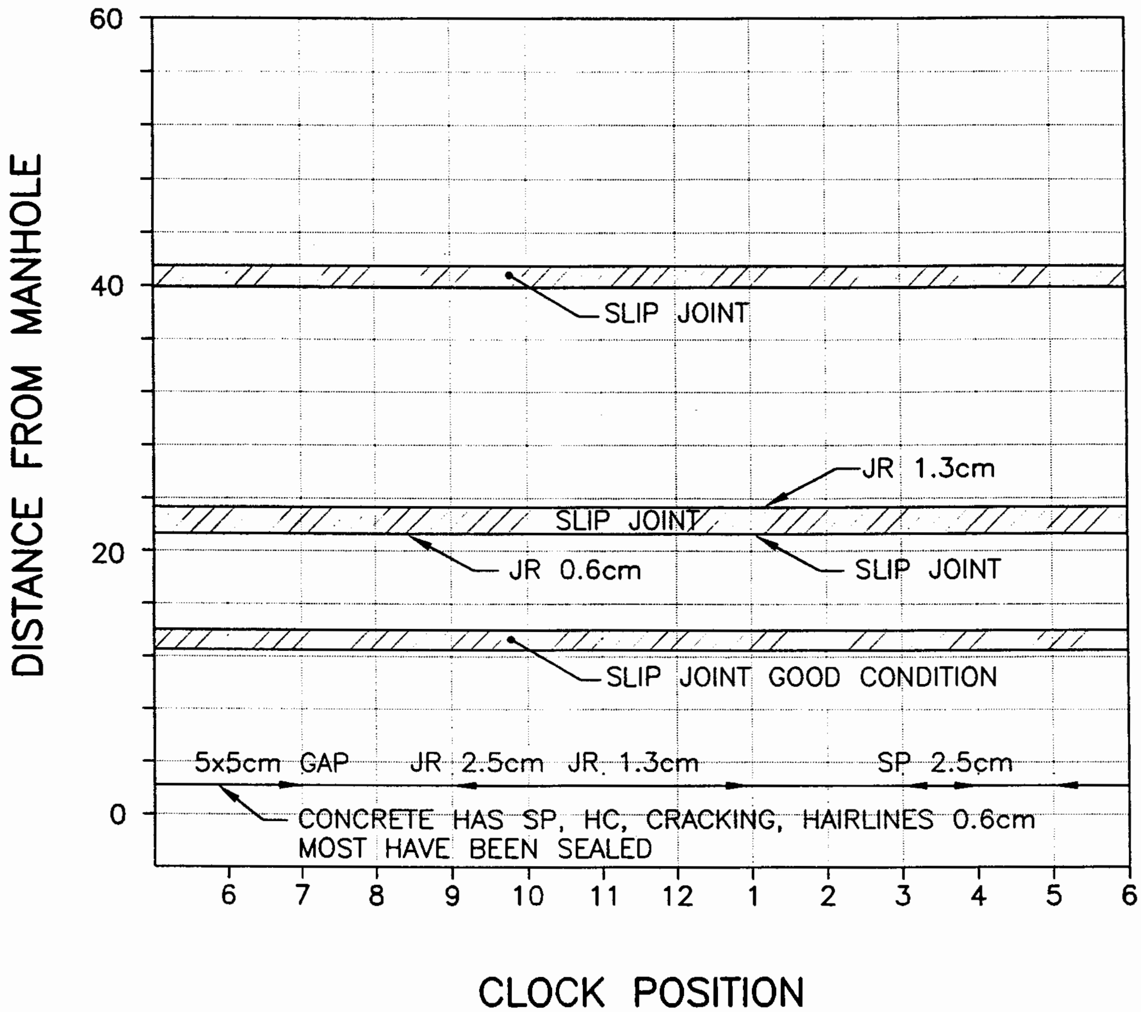
Clock Reference Looking
DOWNSTREAM

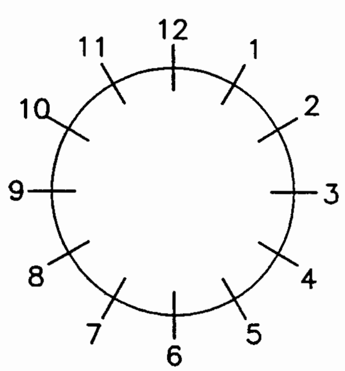
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R43	

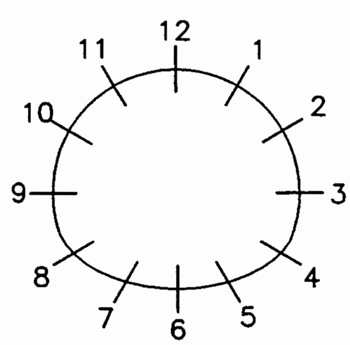
KGS FILE NO.: 97-107-12R43

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



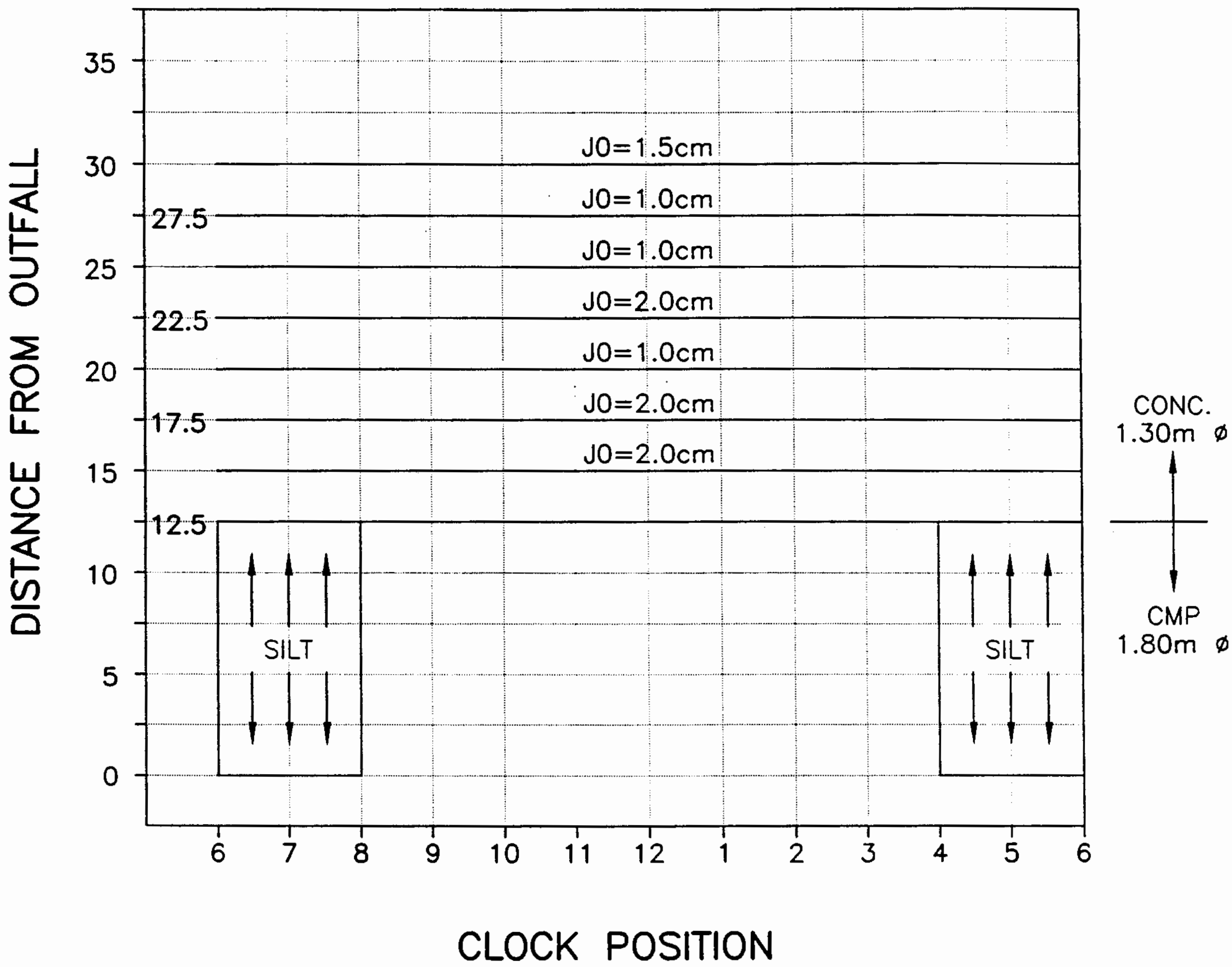
Clock Reference Looking
DOWNSTREAM

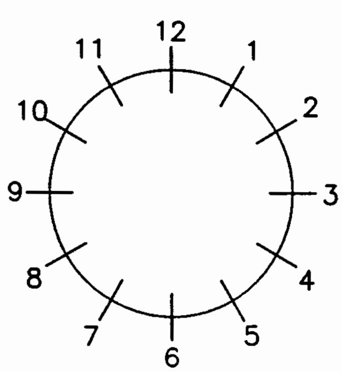
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R44	

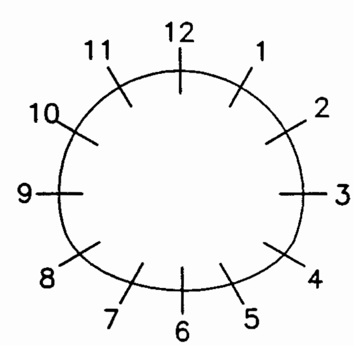
KGS FILE NO.: 97-107-12R44

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



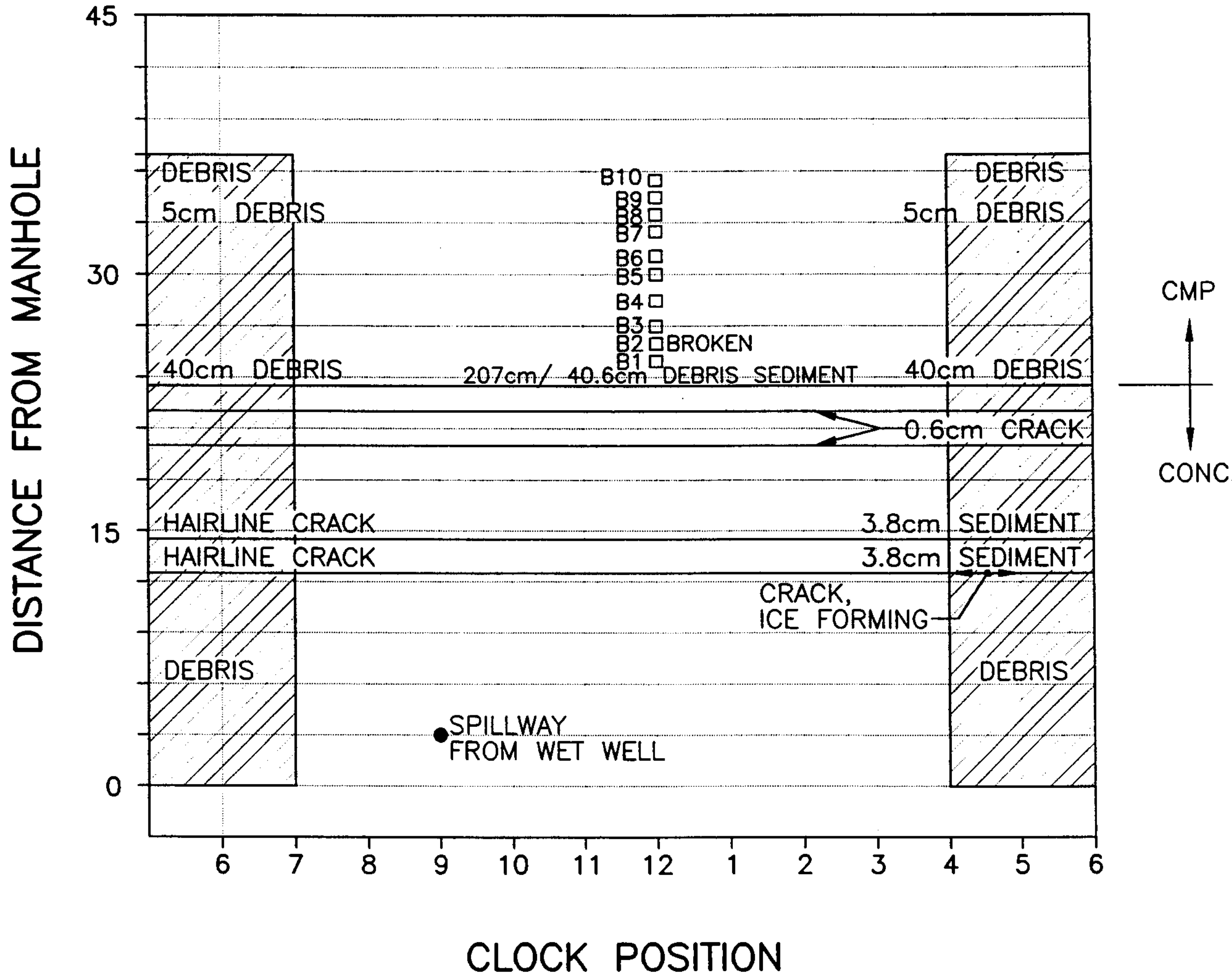
Clock Reference Looking DOWNSTREAM

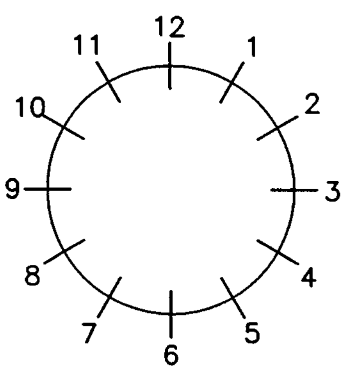
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R45	

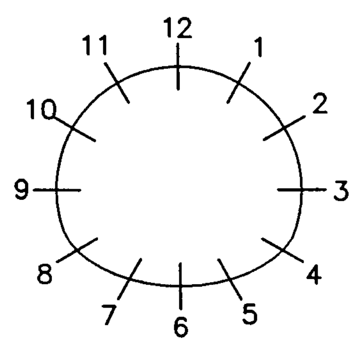
KGS FILE NO.: 97-107-12R45

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



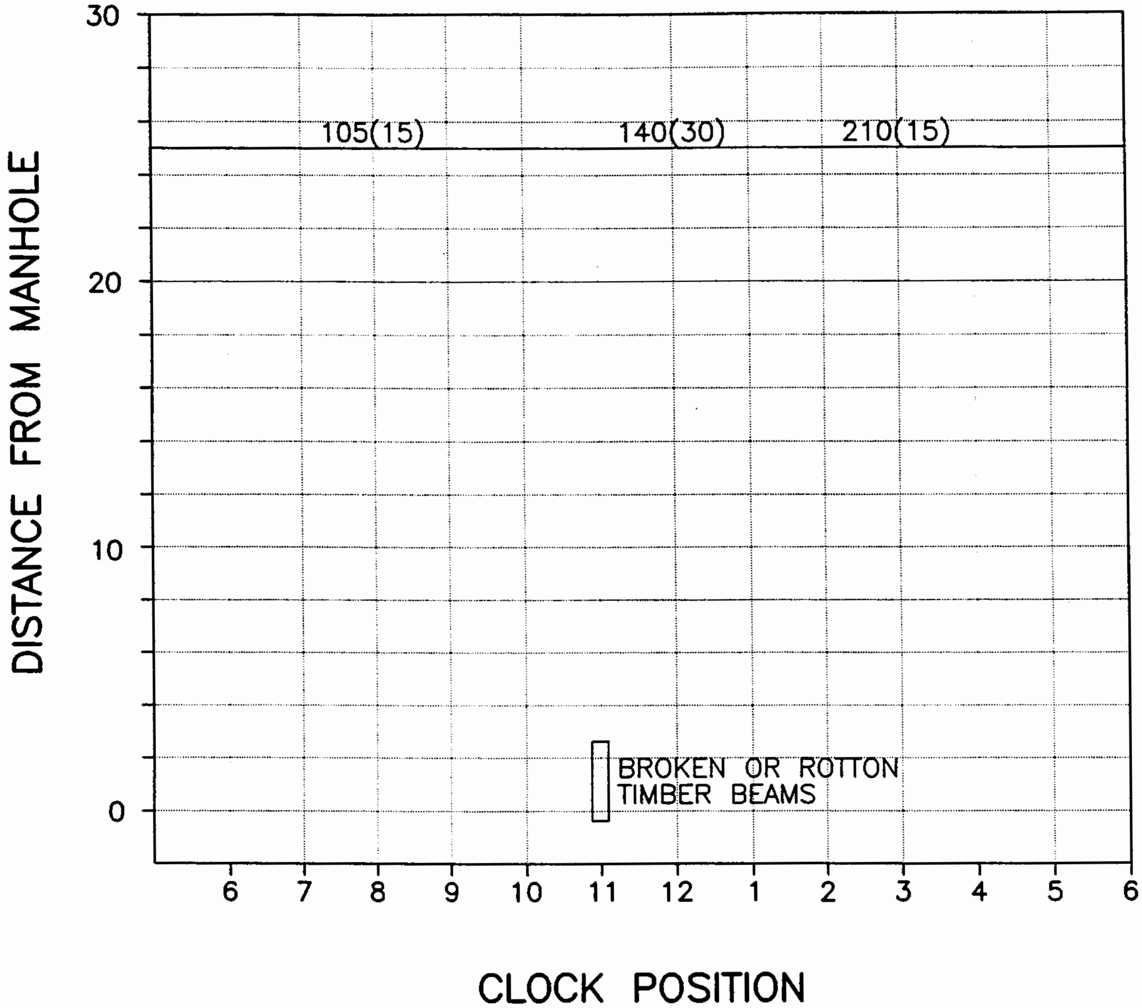
Clock Reference Looking
DOWNSTREAM

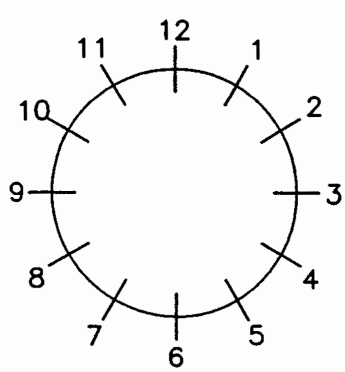
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
B10 □ VERTICAL SUPPORT BEAM	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R46	

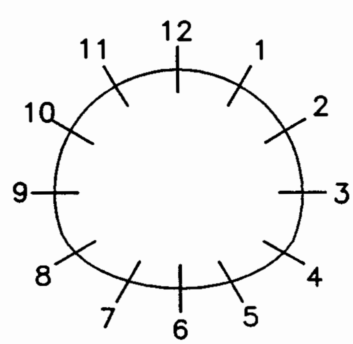
KGS FILE NO.: 97-107-12R46

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM

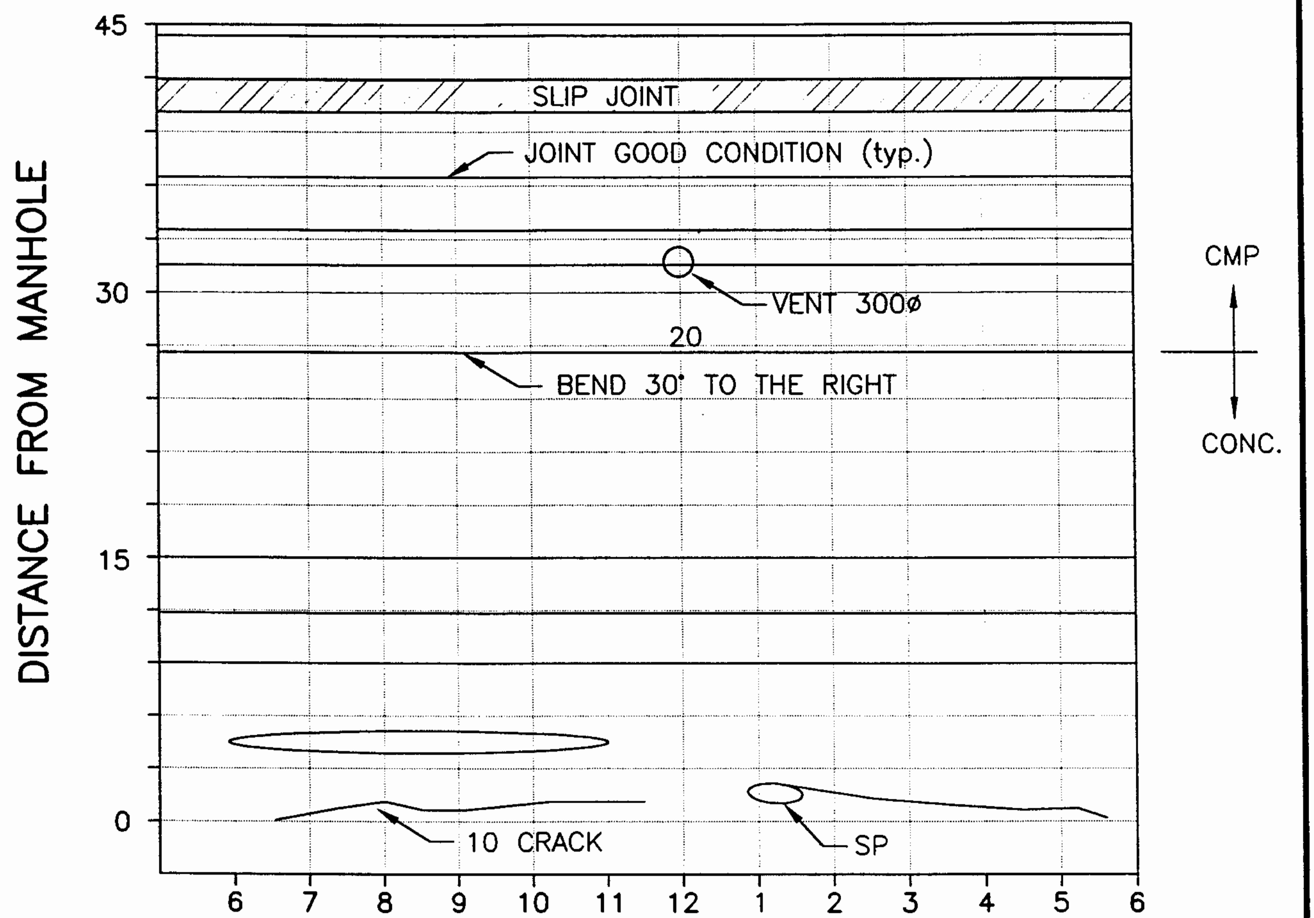


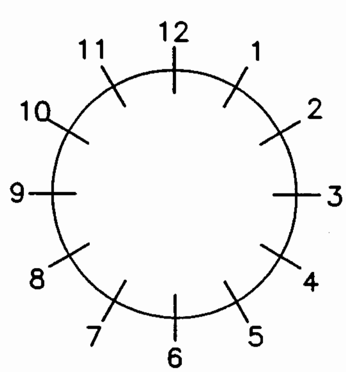
Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R48	

STRUCTURE CONDITION MAPPING CHART





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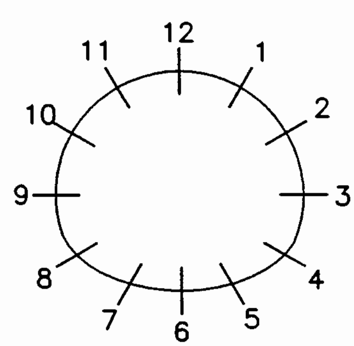


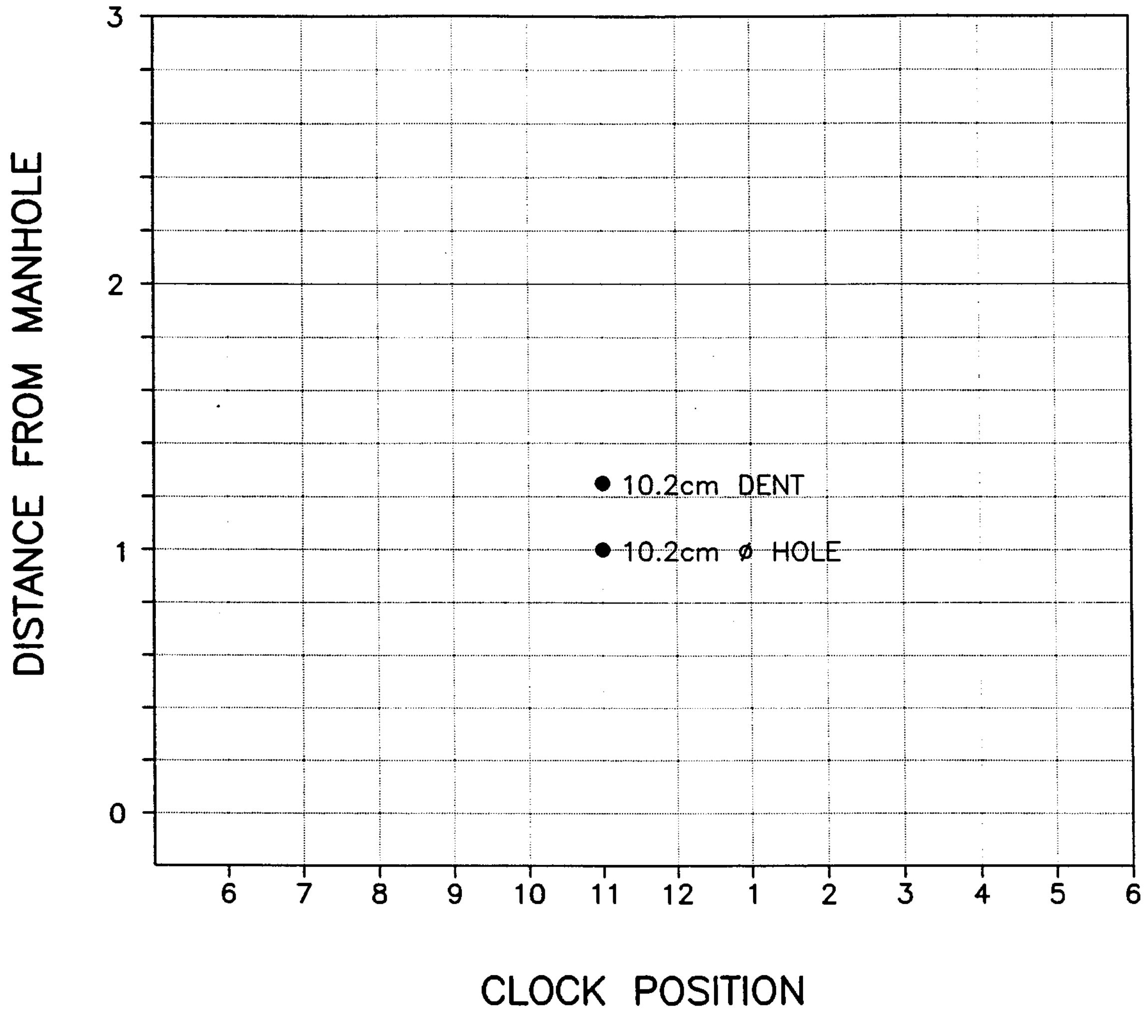
Clock Reference Looking
DOWNSTREAM

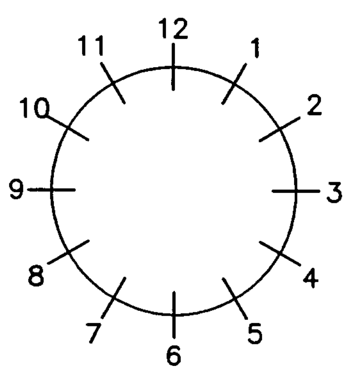
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R49	

KGS FILE NO.: 97-107-12R49

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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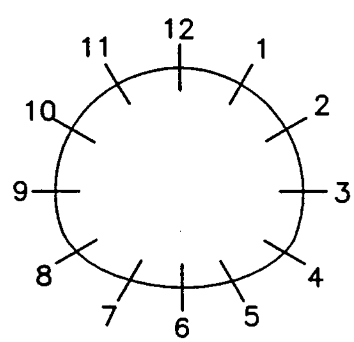


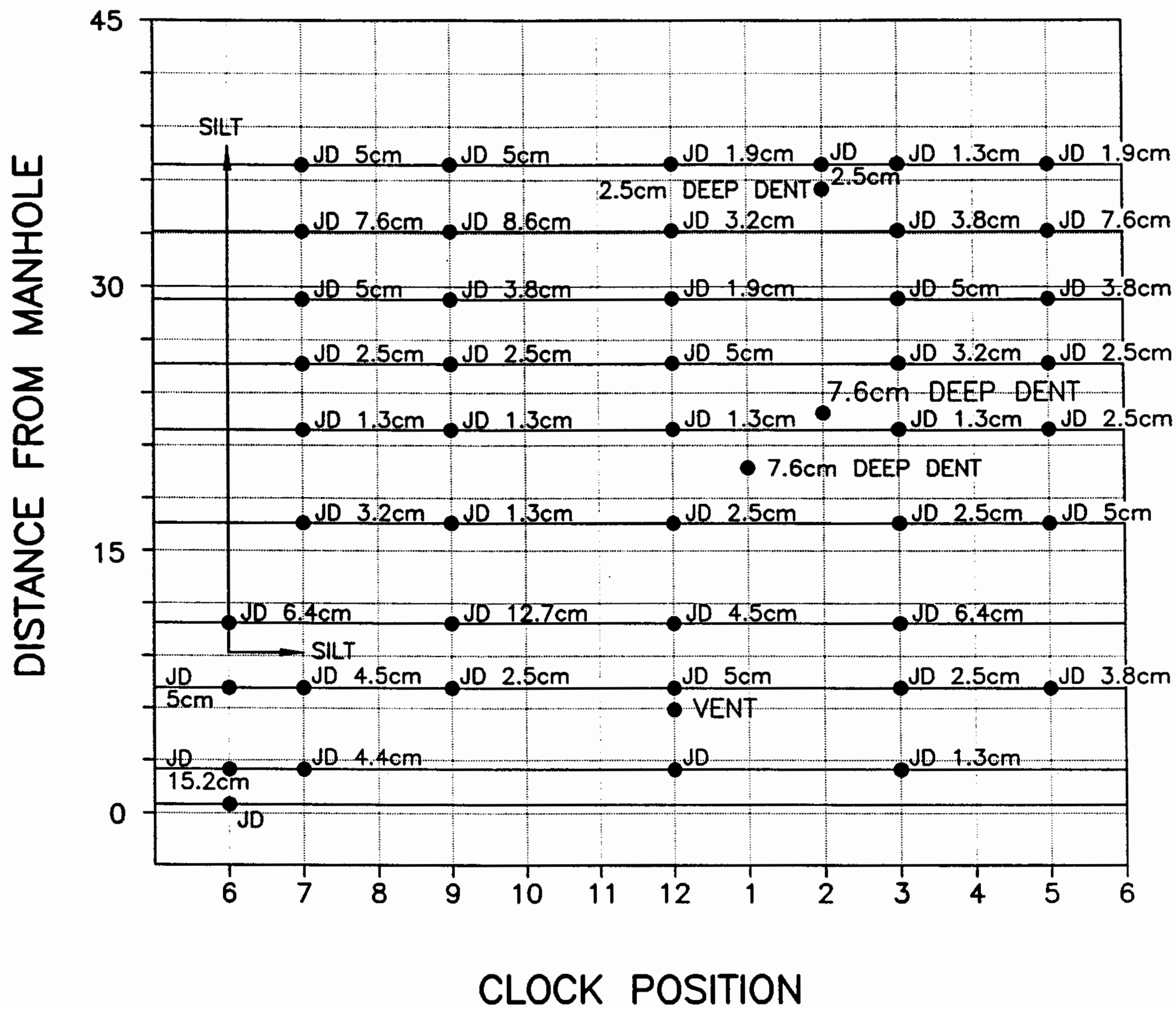
Clock Reference Looking
DOWNSTREAM

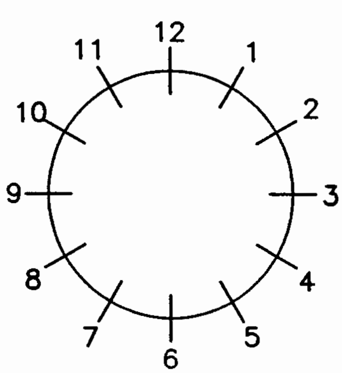
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R51	

KCS FILE NO.: 97-107-12R51

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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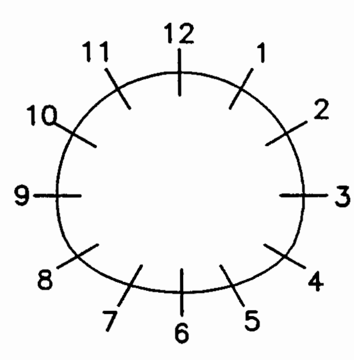
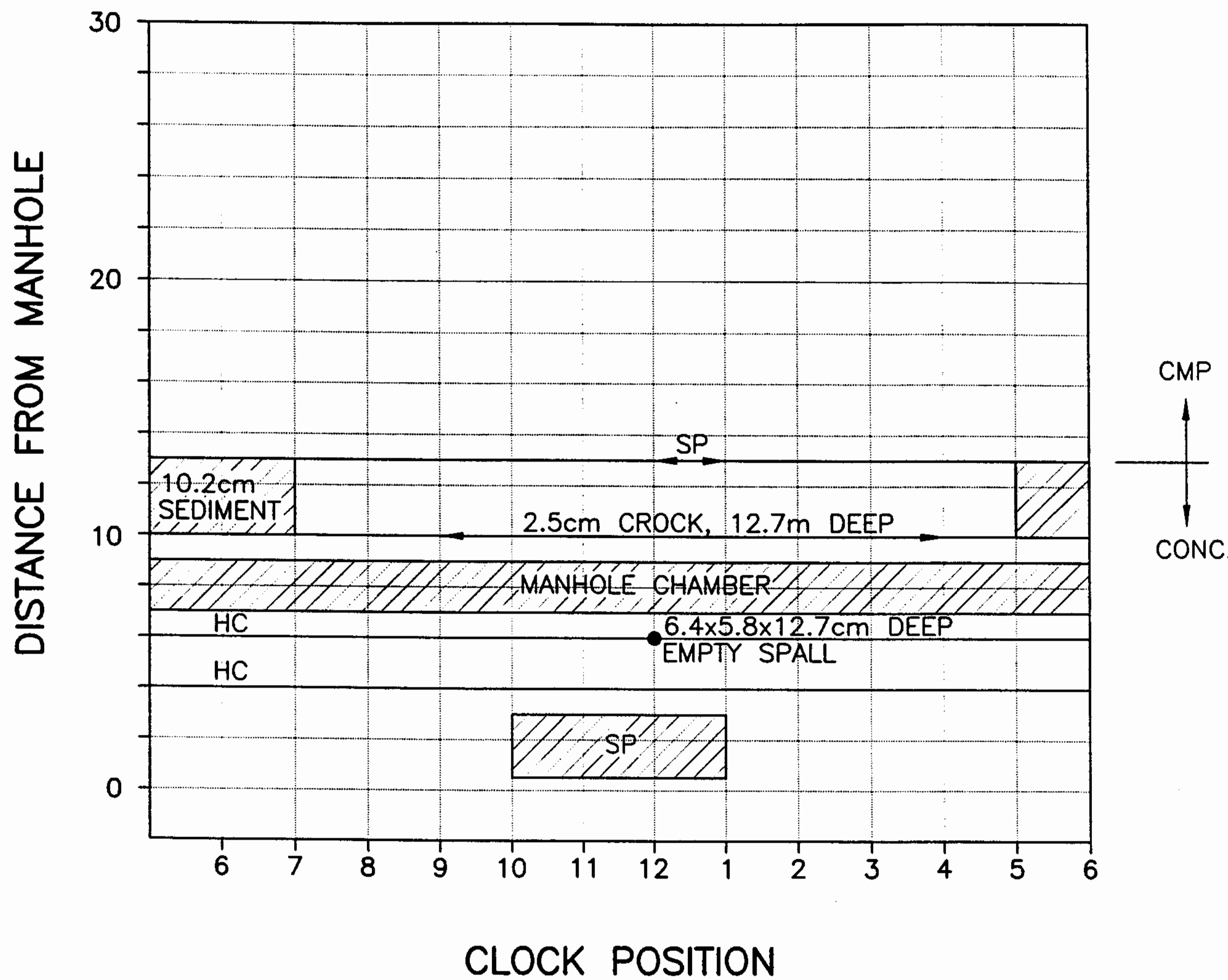


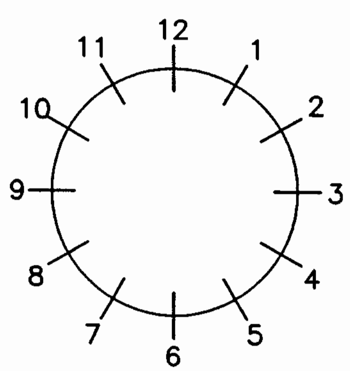
Clock Reference Looking
DOWNSTREAM

LEGEND:

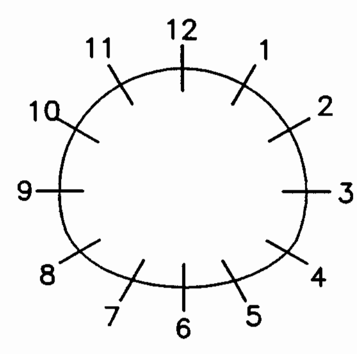
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R52	

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM

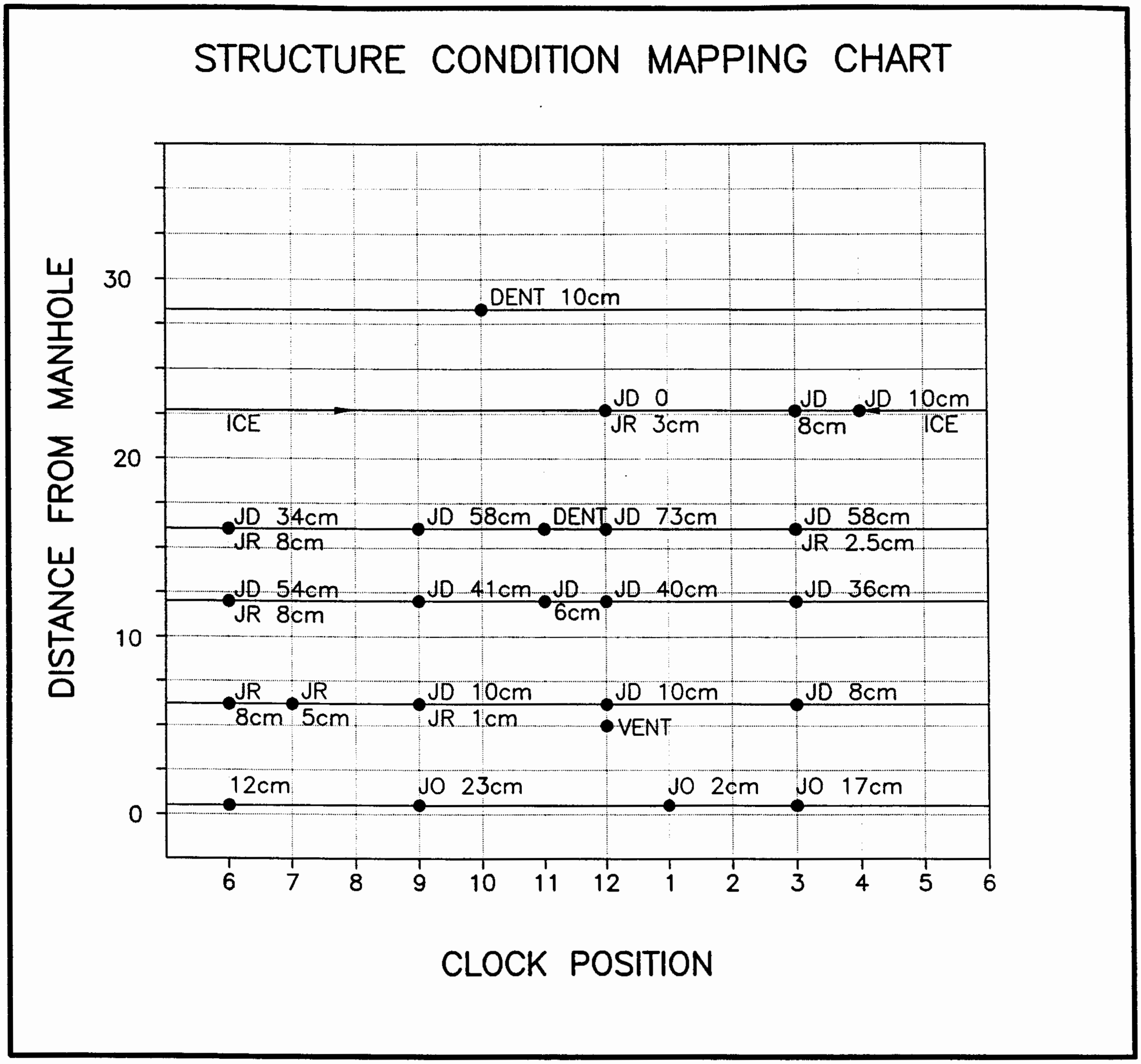


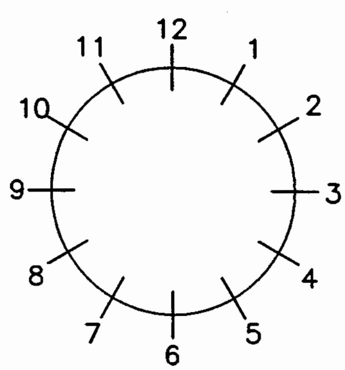
Clock Reference Looking DOWNSTREAM

LEGEND:

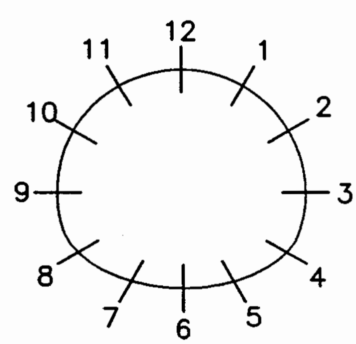
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R54	

KGS FILE NO.: 97-107-12R54





Clock Reference Looking DOWNSTREAM



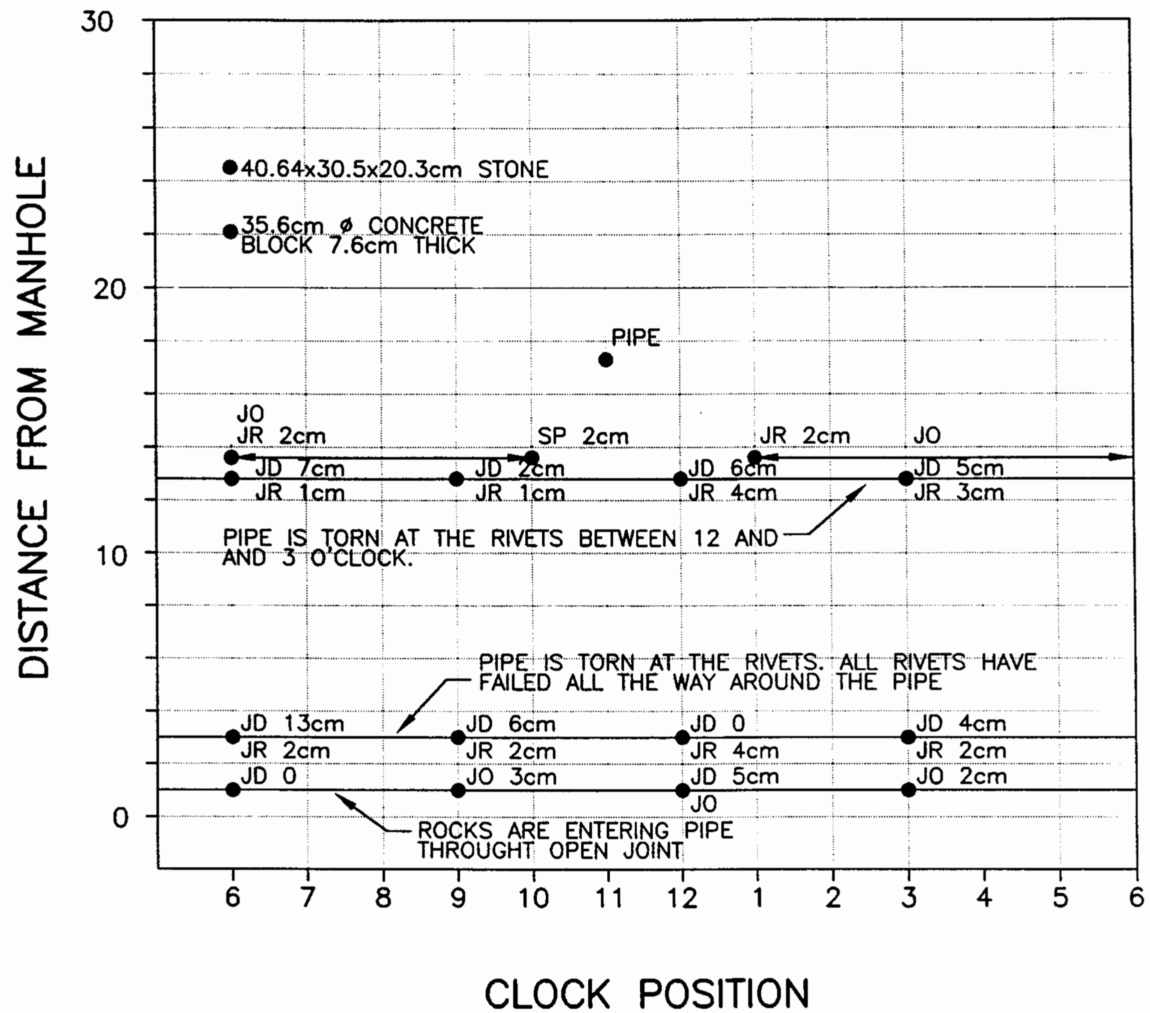
Clock Reference Looking DOWNSTREAM

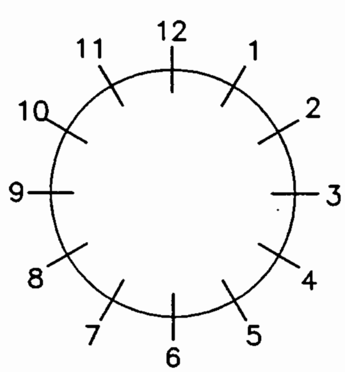
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R55	

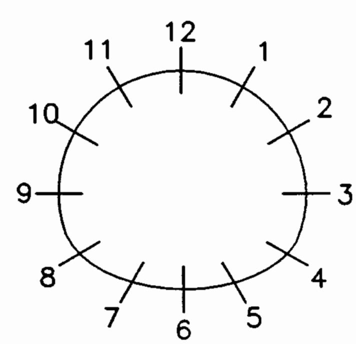
KGS FILE NO.: 97-107-12R55

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



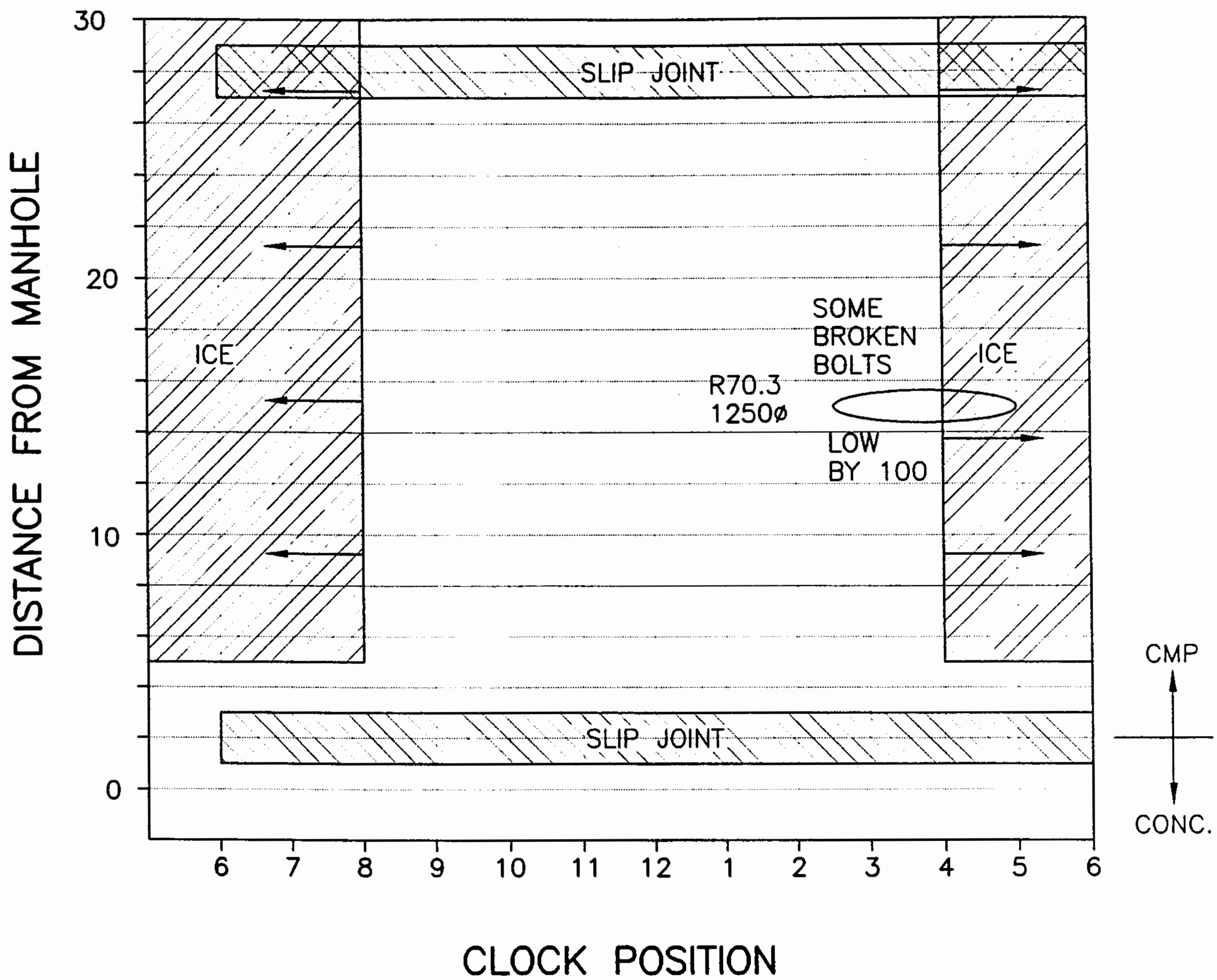
Clock Reference Looking DOWNSTREAM

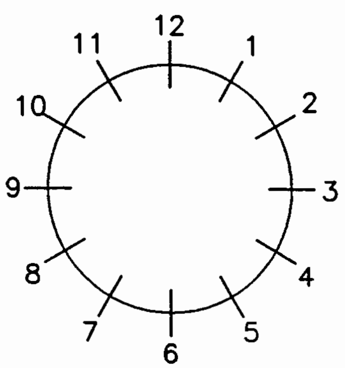
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R58	

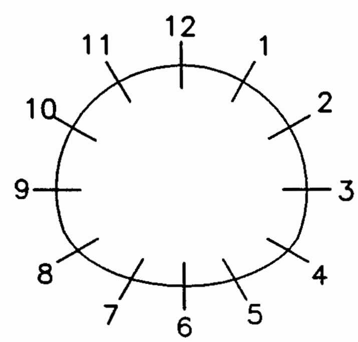
KCS FILE NO.: 97-107-12R58

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



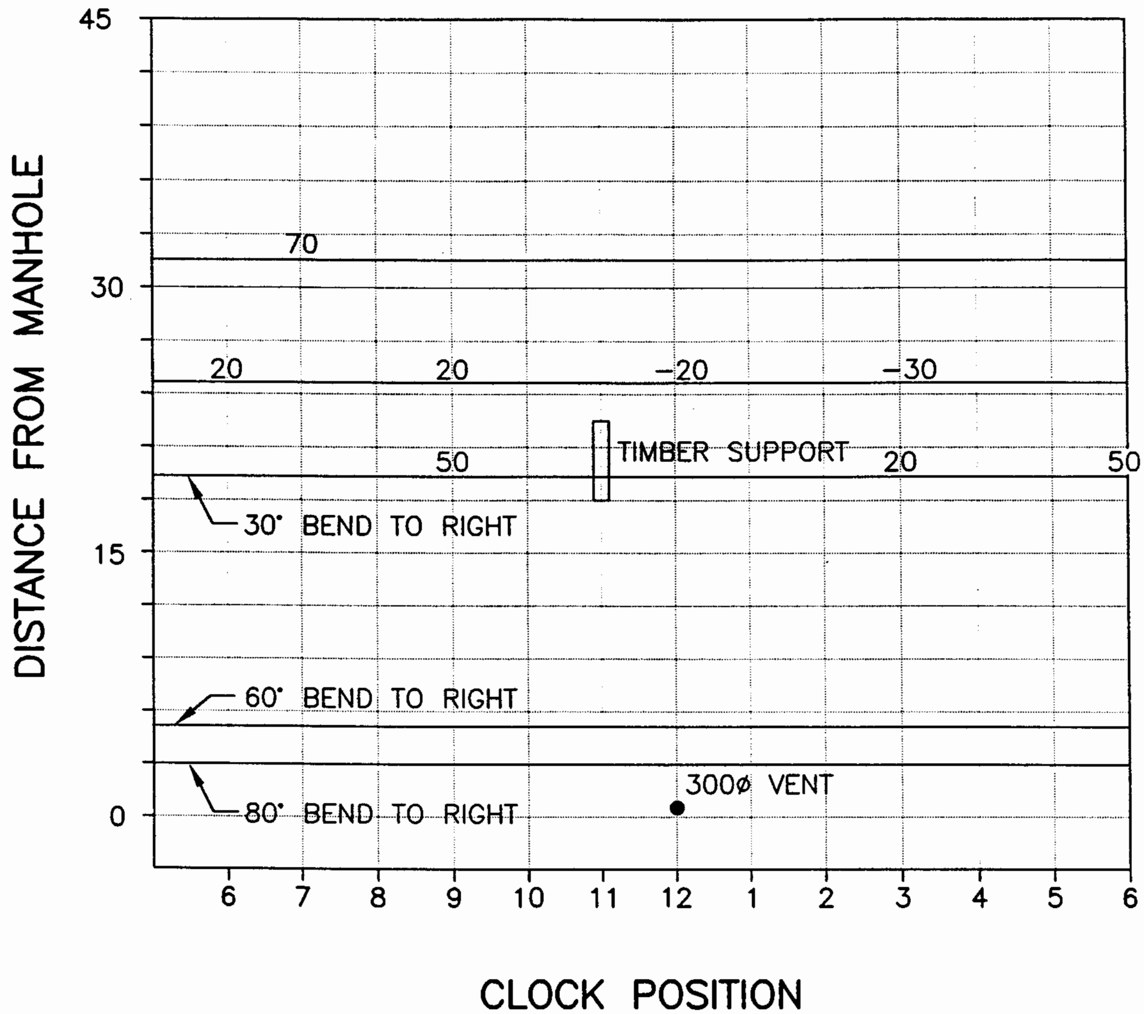
Clock Reference Looking
DOWNSTREAM

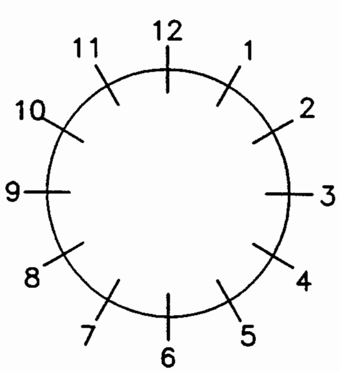
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R70	

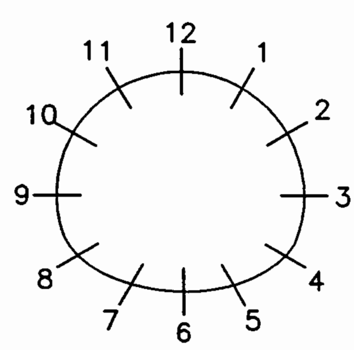
KGS FILE NO.: 97-107-12R70

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM

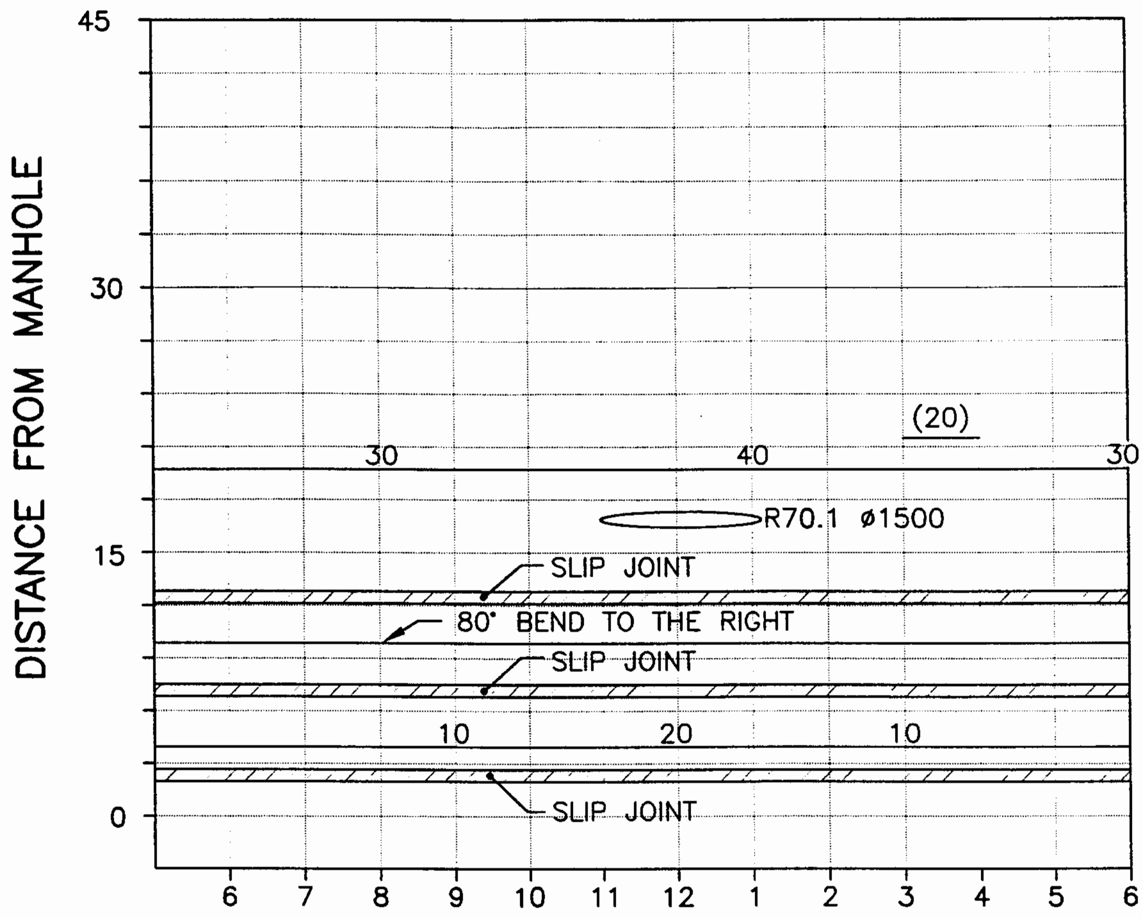


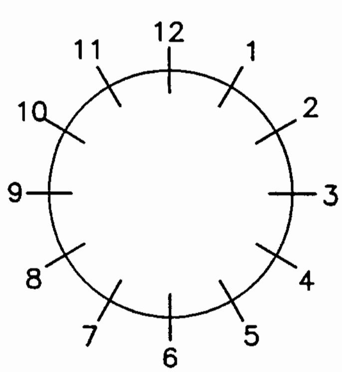
Clock Reference Looking
DOWNSTREAM

LEGEND:

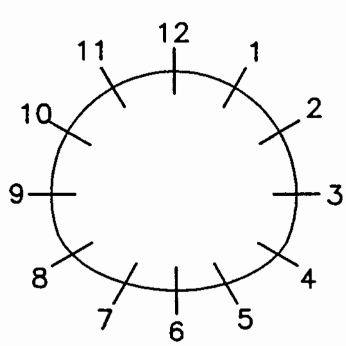
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R70.1	

KGS FILE NO.: 97-107-12R70.1





Clock Reference Looking DOWNSTREAM



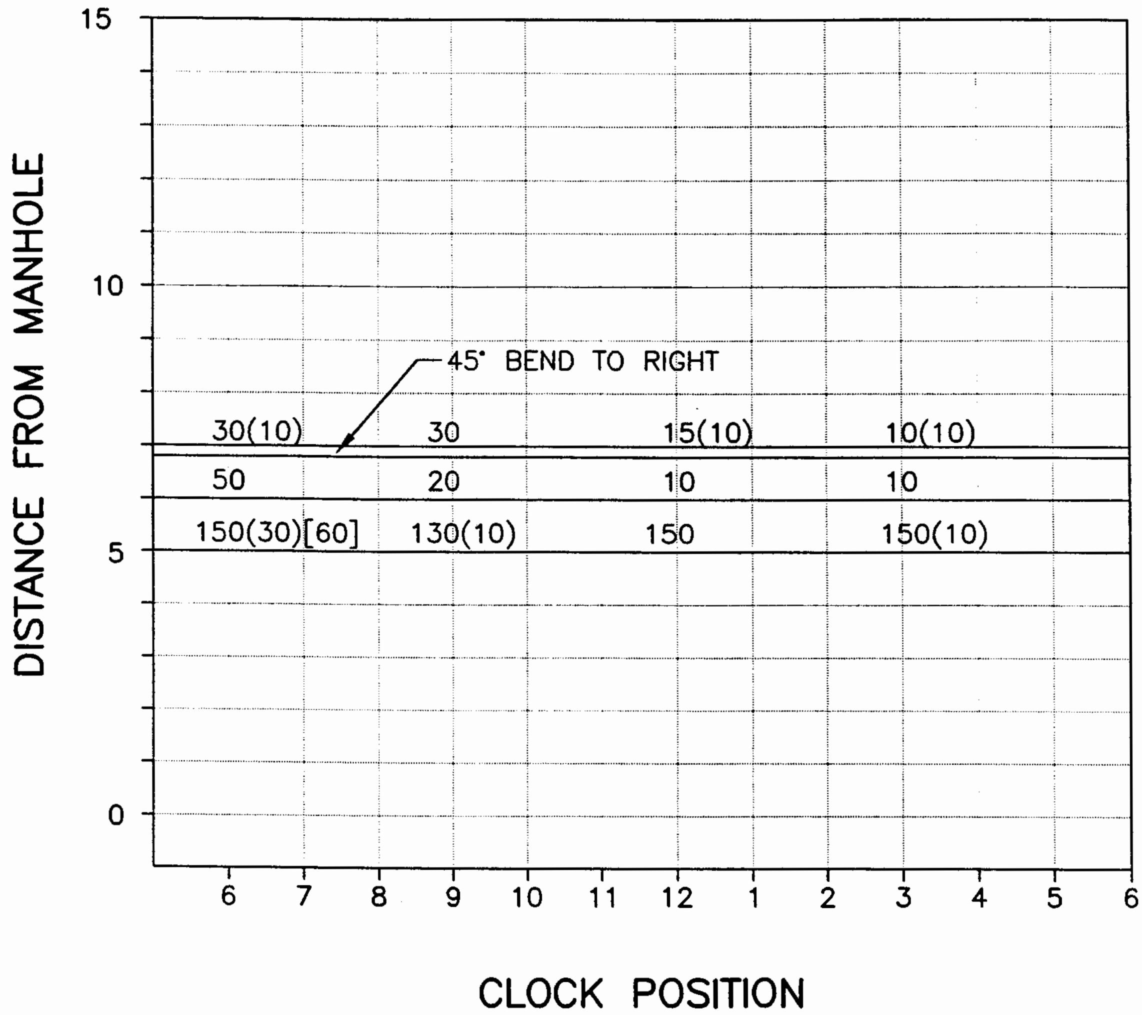
Clock Reference Looking DOWNSTREAM

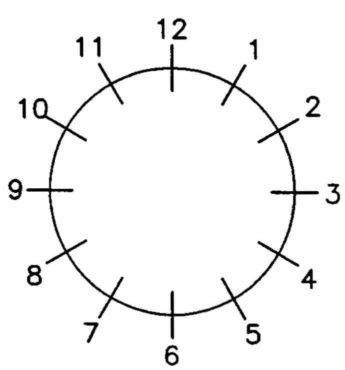
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R70.2	

KGS FILE NO.: 97-107-12R70.2

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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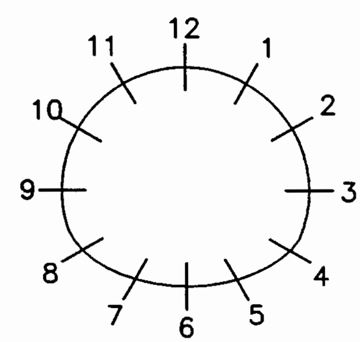


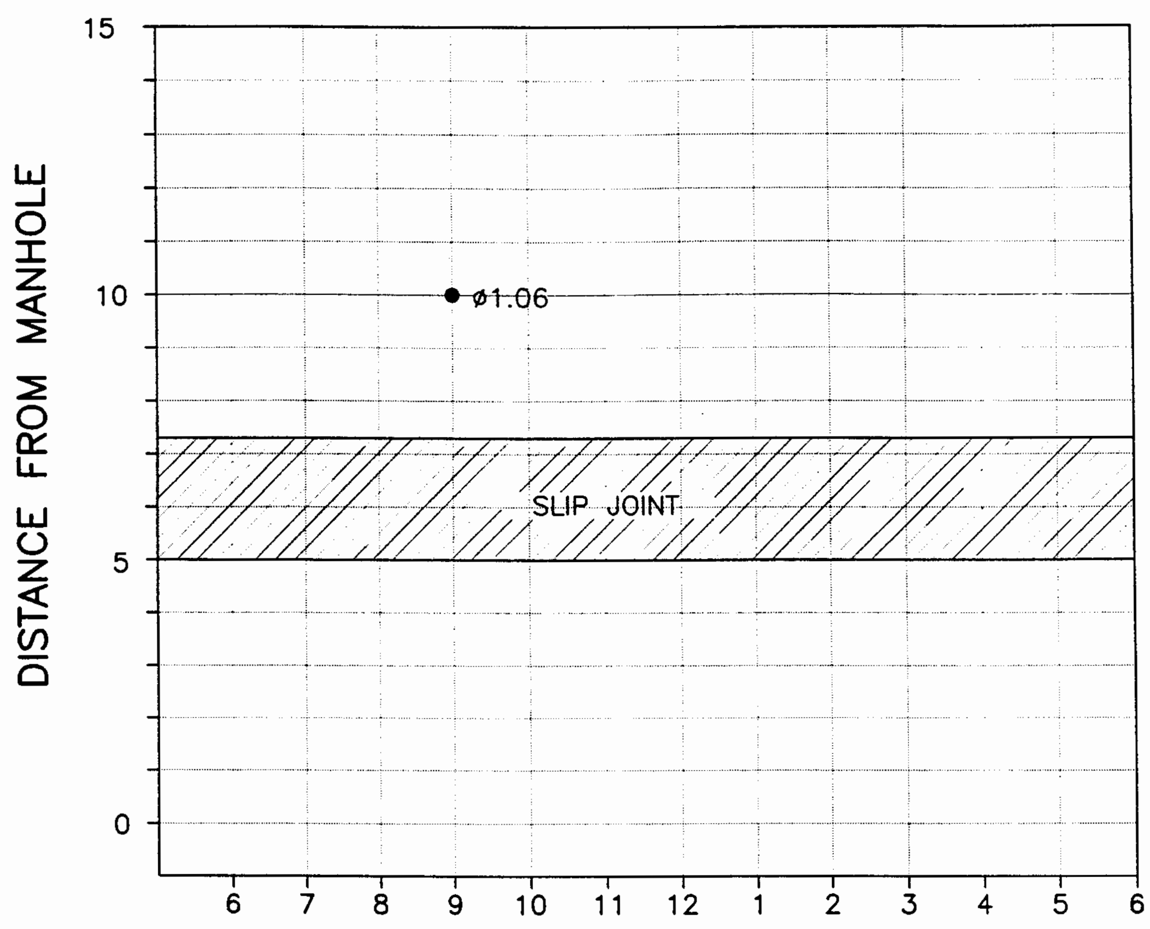
Clock Reference Looking
DOWNSTREAM

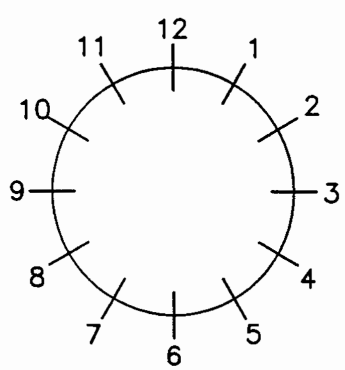
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R71	

KGS FILE NO.: 97-107-12R71

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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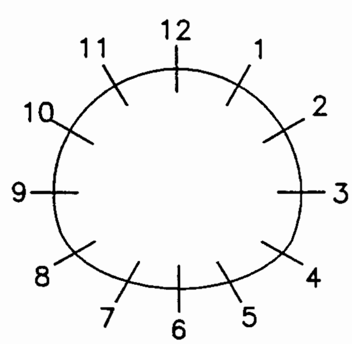


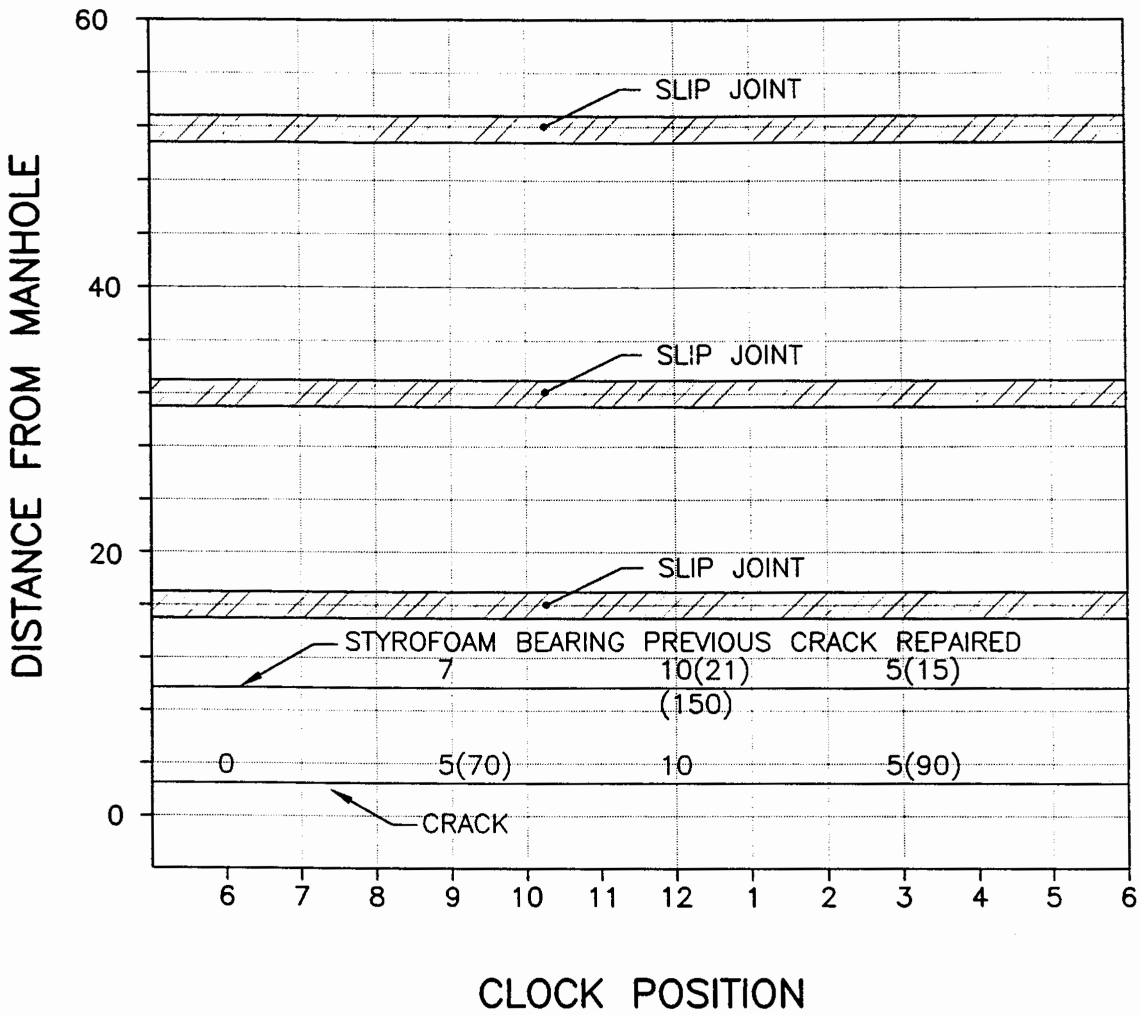
Clock Reference Looking
DOWNSTREAM

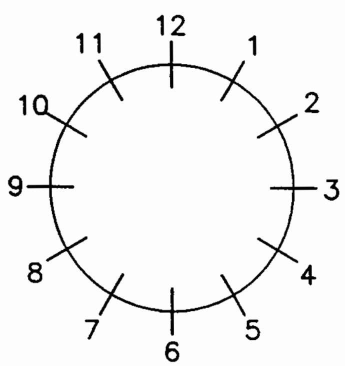
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R72	

KGS FILE NO.: 97-107-12R72

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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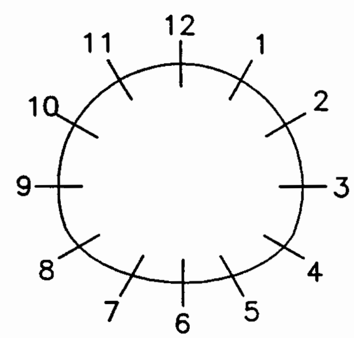
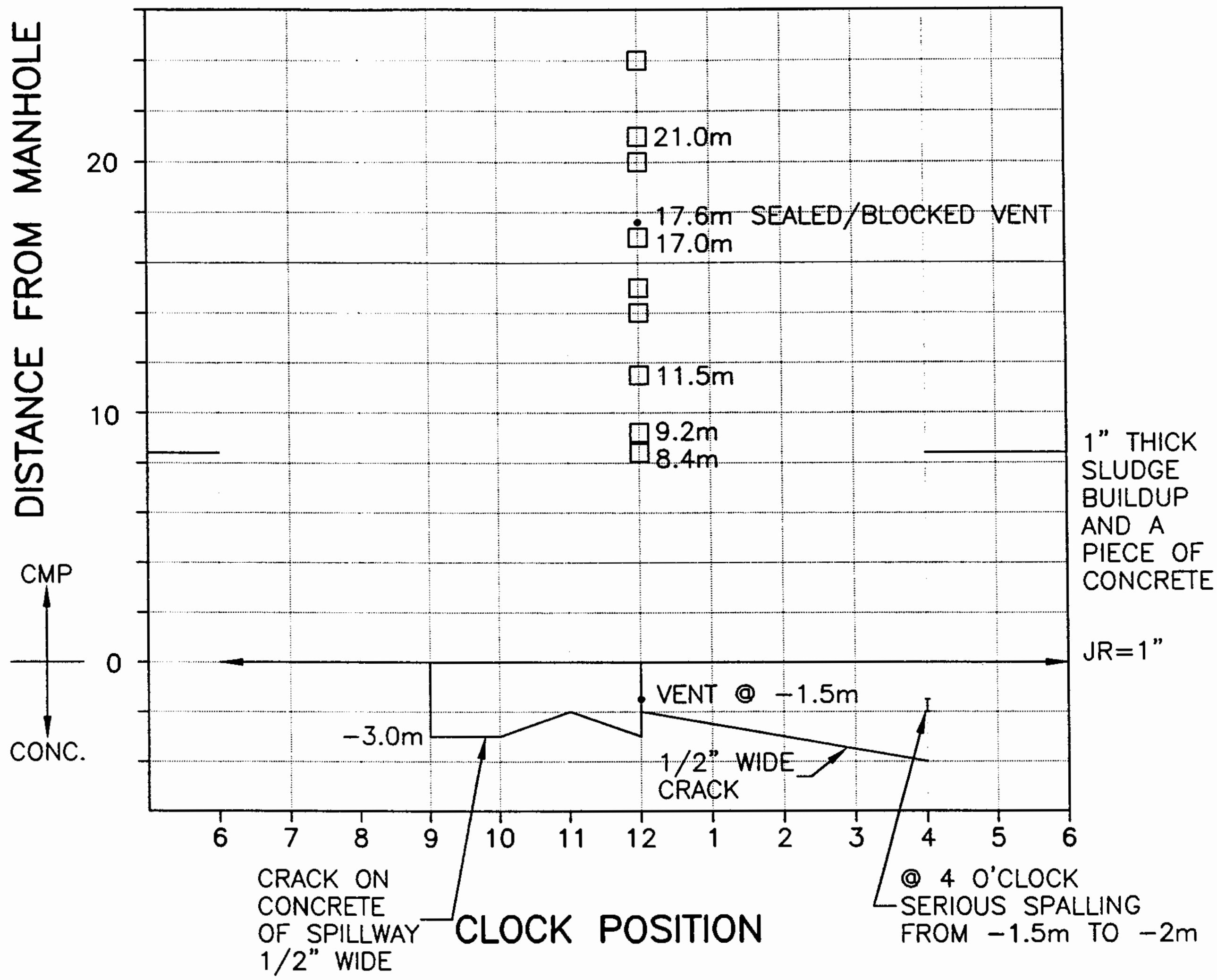


Clock Reference Looking
DOWNSTREAM

LEGEND:

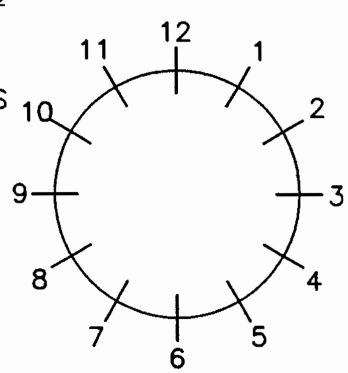
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R74	

STRUCTURE CONDITION MAPPING CHART

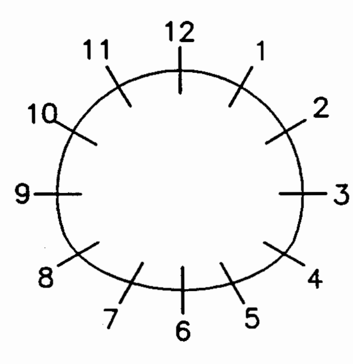


LEGEND

☐ 4"x4" WOOD BRACES



Clock Reference Looking DOWNSTREAM



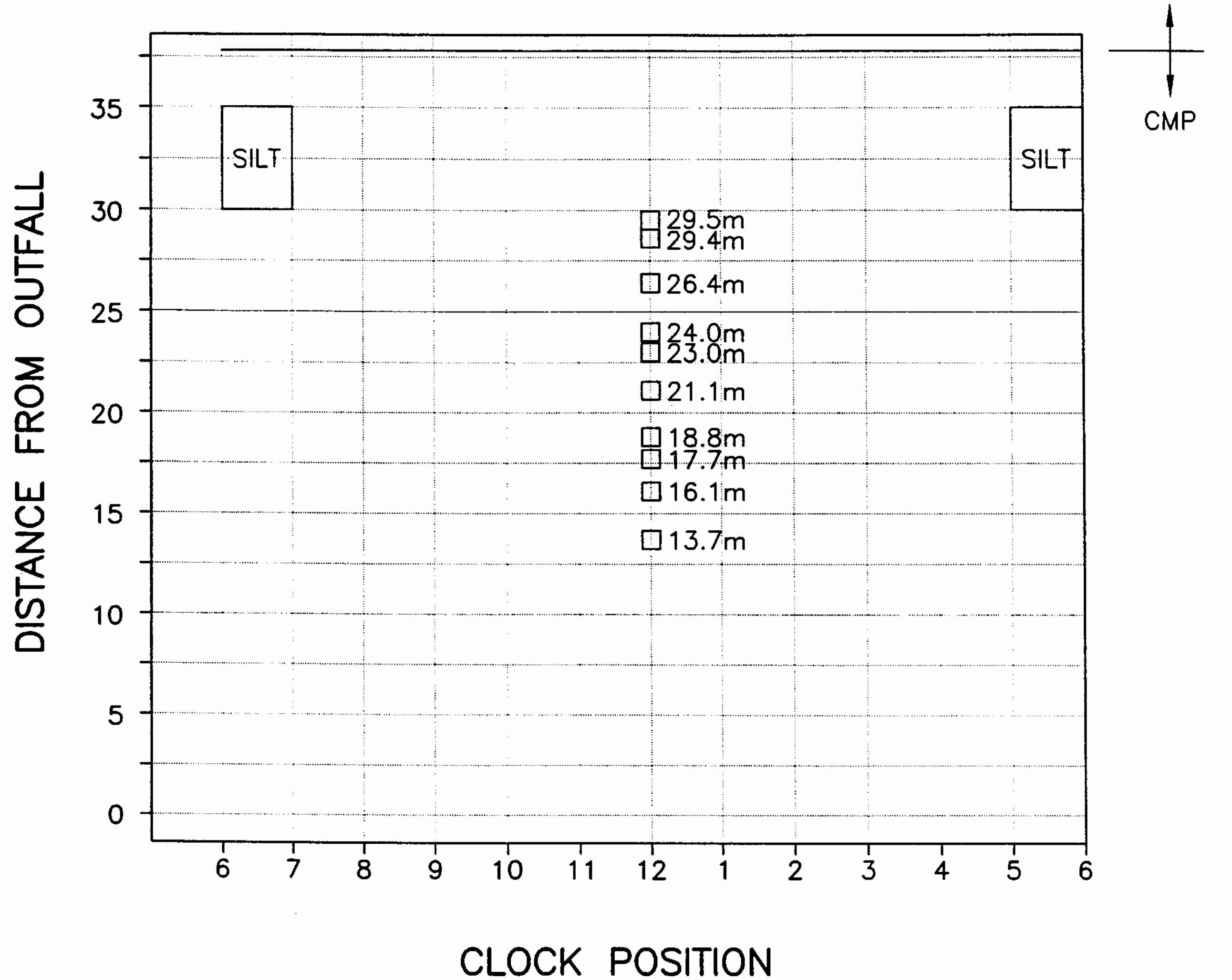
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R79	

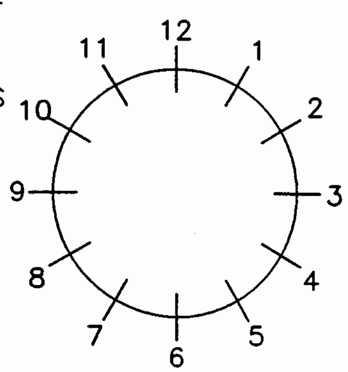
KGS FILE NO.: 97-107-12R79

STRUCTURE CONDITION MAPPING CHART

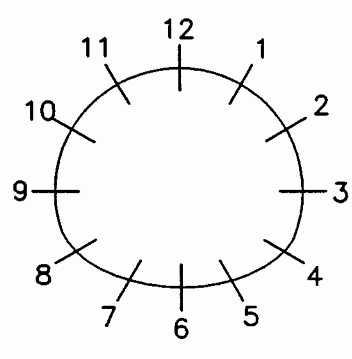


LEGEND

☐ 4"x4" WOOD BRACES



Clock Reference Looking DOWNSTREAM



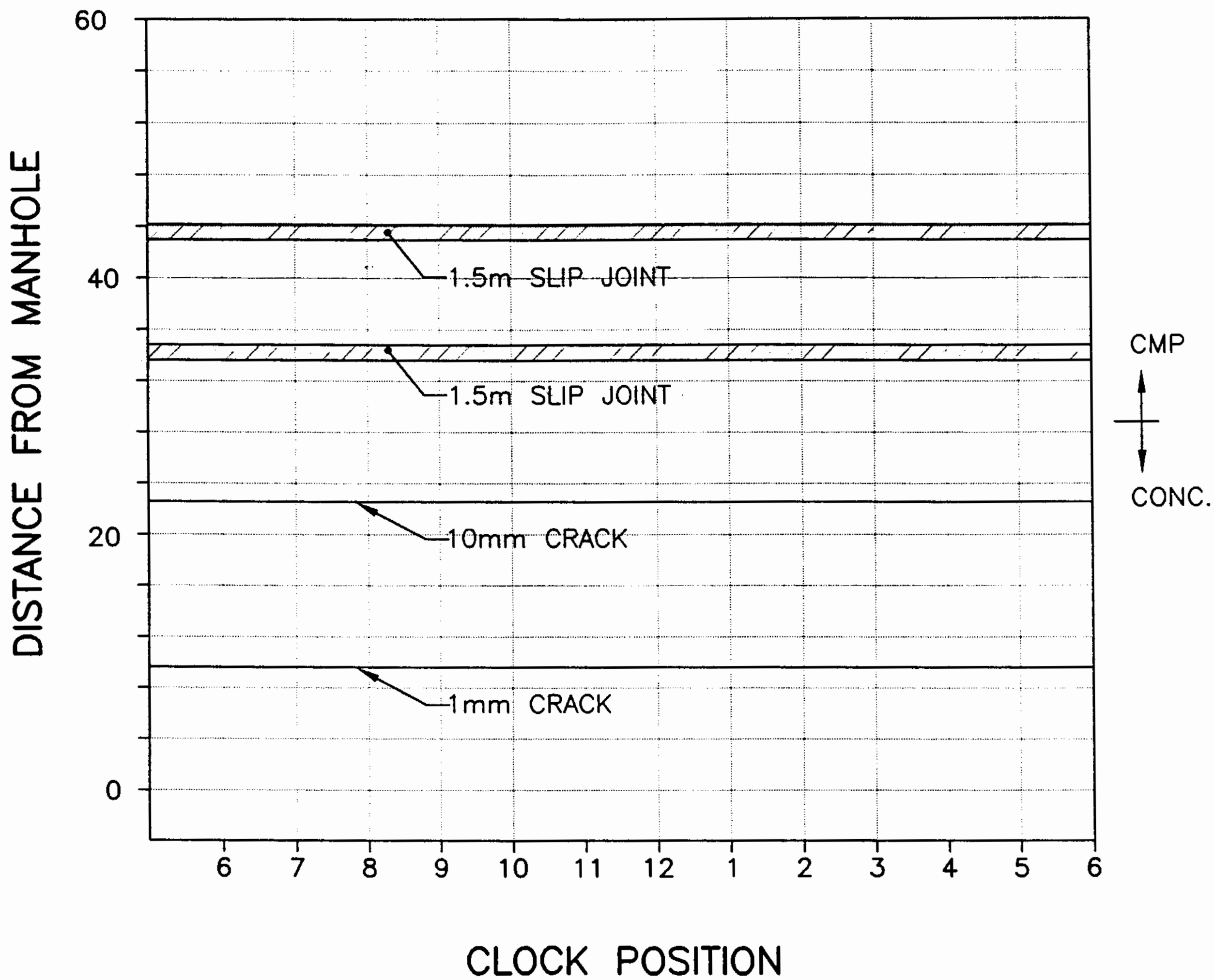
Clock Reference Looking DOWNSTREAM

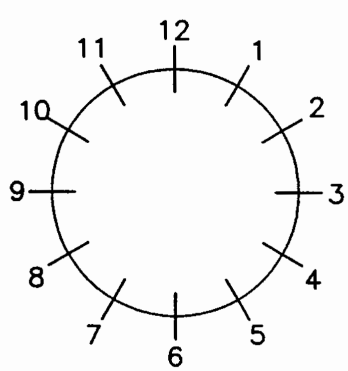
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R79	

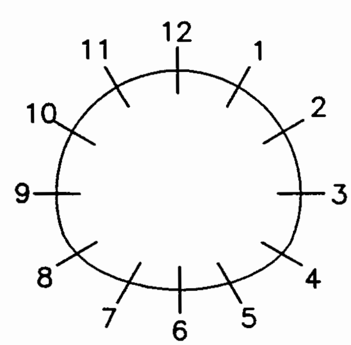
KGS FILE NO.: 97-107-12R79

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R80	

KGS FILE NO.: 97-107-12R80

APPENDIX D

OUTFALLS INSPECTED PHASE 1 AND 2

Outfall ≤ 300 mm - Inspected 1996

Outfall ID	Name	Type	Size
AS-26	Ridgedale S.P.S.	WWS	250
AS-57	Douglas Park Rd.	CS	300
AS-70	Empress Street	LDS	300
AS-71	Empress Street 2	LDS	300
AS-8	St. Charles St. 1	WWS	250
AS-9.9	Sheir Dr.	WWS	250
RR-3	St. Norbert X-Kalay Lift Station Overflow	WWS	300
RR-73	Disraeli Bridge	LDS	300
RR-75	Pritchard Ave.	CS	250

Outfall > 300 mm and < 1200 mm - Inspected 1996

Outfall ID	Name	Type	Size
AS-12	Glasworthy Pl.	LDS	450
AS-14	Coleridge Park Dr. South	LDS	450
AS-15	Paradise Bay	LDS	600
AS-16.5	Orchard Park	LDS	600
AS-21.5	Landoo Dr.	LDS	900
AS-22	Harstone Rd.	LDS	450
AS-23	Dieppe Rd.	WWS	650
AS-25	Shenfield Rd.	LDS	450
AS-27	Ridgedale Cres.	LDS	450
AS-28	Country Club Blvd.	LDS	900
AS-29	Woodhaven Blvd.	CS	450
AS-33	Olive St.	CS	750
AS-37	Strathmillan Rd.	CS	900
AS-38	Vialoux Dr. Cul-de-Sac	LDS	750
AS-62	Parkside Dr.	CS	750
AS-65	St. James Underpass	LDS	900
AS-78	Elm St.	CS	762
AS-83	Arlington St. 1	CS	375
AS-9	St. Charles St. 2	LDS	900
AS-91	Kennedy St.	CS	760
AS-93	Hargrave St.	CS	700
RR-104	Red River Blvd.	LDS	750
RR-108	Eastwood Dr.	LDS	525
RR-2	Lemay Ave.	LDS	900
RR-26	Crane Ave.	CS	600
RR-27	Crane Ave. Outfall	CS	900
RR-28	Dowker Ave. Outfall	LDS	900
RR-30	Lotus Lane	LDS	600
RR-32	Glenview Ave.	LDS	525
RR-34	Oakcrest Pl.	LDS	375
RR-35	Wildwood Golf Coarse	CS	900
RR-37	Calrossie Blvd.	CS	450
RR-40	Kingston Row Underpass	LDS	750
RR-41	Churchill Dr. Underpass	LDS	800
RR-42	Edinburgh St.	CS	800
RR-58	Rue Dumoulin 3	CS	1060
RR-60	Rue La Verendrye FPS	CS	600
RR-68	Archibald Underpass	LDS	750
RR-82	Bredin Dr.	LDS	450
RR-96	Larchdale Cres. SPS	LDS	1050

Outfall ≥ 1200 mm - Inspected 1996

Outfall ID	Name	Type	Size
AS-16.1	Raquette St. 2	LDS	1800
AS-18	McCallum Cres.	LDS	1350
AS-35	Vialoux Dr.	LDS	1500
AS-42	Conway CS	CS	2500
AS-61	Doncaster St.	CS	2250
AS-69	Tylehurst St.	CS	2300
AS-75	Clifton St.	CS	2300
AS-76	Ash St FPS	CS	2100
AS-80	Aubrey St. FPS	CS	2850
AS-86	Cornish Ave FPS	CS	1600
AS-87	Arbuthnot	CS	1400
AS-88	Cornish St. 2	CS	1500
AS-90	Colony St.	CS	1800
AS-94	Donald St.	CS	1900
AS-95	Assiniboine Ave. - FPD	CS	1350
BU-1	Henderson Hwy.	LDS	1375
BU-10	Uxbridge Rd. N.	LDS	1200
BU-2	Henderson Hwy. 2	LDS	1200
RR-10	Radcliffe 1	LDS	1200
RR-100	Whellams Lane	WWS	1200
RR-101	John Black Ave.	LDS	1800
RR-103	Valhalla Dr.	LDS	1675
RR-12	Kings Dr.	LDS	1500
RR-15	Rivergate Dr.	WWS	1350
RR-17	Minnetonka	LDS	2100
RR-19	Banning Rd.	LDS	1370
RR-20	Darcy Dr.	CS	2200
RR-22	Plaza Dr.	LDS	2400
RR-23	Riviera Cres. Outfall	LDS	2000
RR-24	Falconer Bay	LDS	1200
RR-31	Dunkirk Dr.	LDS	1400
RR-33	Dunham Rd.	LDS	900
RR-36	Somerset Ave.	CS	1800
RR-38	Cockburn St. FPS	CS	1500
RR-39	Cockburn St. Lift Station Outfall	CS	1800
RR-43	Killarney St.	LDS	1200
RR-44	Mager St. FPS	LDS	1800
RR-46	Metcalfe Pl.	CS	2000
RR-48	Glasgow Ave.	LDS	1200
RR-49	Jessie Ave	CS	1900
RR-51	Marion St. FPD	CS	1600
RR-52	Marion St. 2	CS	1800
RR-54	Rue Despins	CS	1400
RR-55	Rue Despins FPD	CS	1200
RR-57	Rue Dumoulin 2	CS	1200
RR-7	Perimeter Hwy. at Cloutier Dr.	CS	1800

Outfall ≥ 1200 mm - Inspected 1996

Outfall ID	Name	Type	Size
RR-70	Watt St.	CS	3700
RR-70.1	Watt St. 2 (connector pipe)	CS	1500
RR-70.2	Watt St. 3 (connector pipe)	CS	1850
RR-70.3	Watt St. 4 (connector pipe)	CS	1250
RR-71	Syndicate St. - Flood Pump Discharge	CS	1800
RR-74	Selkirk Ave.	CS	1800
RR-76	Burrows Ave.	CS	2400
RR-79	Hart Ave.	CS	2850
RR-80	St. John's Park MH	CS	3000
RR-83	Polson Ave. FPS	CS	1800
RR-84	Munroe Ave. FPS	CS	2500
RR-88	Jefferson Ave.	CS	3300
RR-9	Rice Dr.	LDS	1500
RR-90	Linden Ave.	CS	1800
RR-91	Linden Ave. - Flood Pump Discharge	CS	1675
RR-94	Newton Ave.	CS	1850
RR-95	Armstrong Ave.	CS	2700
RR-98	Hawthorne Ave.	CS	2200
SE-1	Mission FPS	CS	2600
ST-18	Hamilton Ave.	LDS	1500
ST-21	Crestview Park Dr. (retention pond drainage)	LDS	1676
ST-3	Booth Dr.	LDS	1850

Private Outfall - Inspected 1996

Outfall ID	Name	Type	Size
AS-2	P.T.H. 100 W. Side	LDS	1400
AS-3	P.T.H. 100 W. Side	LDS	1200
AS-4	P.T.H. 100 E. Side	LDS	800
AS-5	P.T.H. 100 E. Side	LDS	1200
AS-5.1	P.T.H. 100 E. Side	LDS	1500
RR-97	Kildonan Park #1	LDS	250
RR-105	Henderson Hwy. (Private)	LDS	600

Outfall > 300 mm and < 1200 mm - Inspected 1997

Outfall ID	Name	Type	Size
AS-10	Pender St.	LDS	900
AS-11	Barker Bvld.	LDS	1075
AS-23.1	Dieppe Rd. 2	WWS	900
AS-60	Chataway Blvd.	CS	900
AS-60B	Chataway Blvd. 2	LDS	600
AS-61A	Edgeland Blvd.	LDS	400
AS-66	King Edward St.	LDS	650
AS-66.8	Wellington Cres. 2	LDS	450
AS-67A	Route 90 Bridge	LDS	450
AS-68	Wellington Cresc.	LDS	500
BU-11	Uxbridge Rd. S.	LDS	900
BU-12	McIvor Ave.	LDS	400
BU-13	Raleigh St. 1	LDS	400
BU-14	Raleigh St. 2	LDS	750
BU-15	Raleigh St. 3	LDS	750
BU-3	Bonner Ave.	LDS	525
BU-6	Delbrook Cres.	LDS	400
LS-2	Rue Des Trappistes	LDS	450
LS-4	La Maire Ave.	LDS	1000
OM-1	Raglan Rd.	LDS	400
OM-3	Empress St. 1	LDS	750
OM-4	Velodrome 1	LDS	380
RR-18	River Pointe Pl.	LDS	1050
RR-21	Bishop Grandin Blvd. 2	LDS	750
RR-25	Moore Ave.	LDS	1100
RR-34.8	Riverdale Ave.	LDS	600
RR-6	Grandmont Blvd.	WWS	750
RR-8	Stormont Dr.	LDS	400
SE-12	Kavanagh St.	LDS	750
SE-2	Rue Laverendrye	LDS	600
SE-21	St. Catherine St. 1	LDS	600
SE-27	Evans Ave.	LDS	1067
SE-28	Cote St.	WWS	450
SE-29	Gareau St.	LDS	800
SE-30	Guay Ave.	LDS	750
SE-30.1	Egerton Rd.	LDS	900
SE-31	Blenheim Ave.	LDS	1060
SE-32	Imperial Ave.	LDS	750
SE-33	Humbolt Ave.	LDS	900
SE-36	Comanche Rd.	WWS	600
SE-37	Fermor Ave.	LDS	600
SE-38	Niakwa Rd. 1	LDS	450
SE-38.1	Niakwa Rd. 2	LDS	450
SE-43	Southbridge Dr.	LDS	900
SE-47	Marlene St.	LDS	530
SE-5	Rue Dumoulin	WWS	600

Outfall > 300 mm and < 1200 mm - Inspected 1997

Outfall ID	Name	Type	Size
ST-11	Kirby Dr.	LDS	600
ST-12	Amarynth Cres. 2	LDS	400
ST-15	Valleyview Dr. 1	WWS	600
ST-16	Valleyview Dr. 2	LDS	1050
ST-17	Harvest Lane	LDS	400
ST-19	Silver Ave.	WWS	525
ST-20	Voyageur	WWS	600
ST-22	Crestview Park Dr.	LDS	762
ST-23	Acheson Dr.	LDS	900
ST-24	Saskatchewan Ave.	LDS	361
ST-6	Setter St.	LDS	600
ST-7	Greenway Cres.	LDS	600
ST-8	Lonsdale Dr.	LDS	600
ST-9	Amarynth Cres.	LDS	525

Outfall ≥ 1200 mm - Inspected 1997

Outfall ID	Name	Type	Size
AS-13	Willow Ridge Rd.	LDS	1800
AS-19	Carroll Rd.	LDS	1800
AS-58	Park Bvld.	LDS	2400
AS-63	Riverbend Cres.	CS	2340
AS-74	Clifton St. FPD	CS	2100
AS-81	Ruby St. 1	CS	2100
BU-9	Pennefather St.	LDS	1350
FL-1	Deacon Reservoir	LDS	1500
FL-2	Kildare at Floodway	LDS	3000
RR-33	Dunham Rd. Outfall	LDS	1200
RR-45	Baltimore St. FPS	CS	1800
RR-50.5	Park Dr.	LDS	1200
RR-59	Rue La Verendrye	CS	1200
RR-63	Bannatyne Ave.	CS	1500
RR-87	Chelsea Pl	LDS	2260
SE-34	Rue Archibald St.	LDS	2700
SE-4	Rue Notre Dame W.	LDS	1220

APPENDIX E
Outfalls Not Inspected

APPENDIX E

OUTFALLS NOT INSPECTED

Outfalls > 300 and < 1200 mm - Not Inspected

Outfall ID	Name	Type	Size	Comments
RR-11	Radcliffe	WWS	760	Debris at bottom of MH and outlet, could not televise
RR-21.1	Bishop Grandin Blvd. 4	LDS	750	Outlet totally submerged
RR-29	Victoria Cres. 2	LDS	750	Outlet is dry, MH chamber is submerged, something blocking line
RR-47	Eccles St.	CS	750	MH chamber submerged, sediment at outlet
RR-56	Water Ave.	CS	457	Outlet not found, flow visible from bank
RR-56.1	Water Ave. 2	CS	450	Outlet not found
RR-61	Lombard Ave.	CS	900	Outlet not found, flow visible from bank
RR-81	Elmwood Park	LDS	900	Cannot access MH in park
AS-31	Oakdale Dr.	LDS	600	Submerged
AS-32	McQuacker Dr.	LDS	1050	MH located west of bridge, not accessible due to snow
AS-67	Wellington cres at CNR Bridge	LDS	450	Curb inlet cannot televise
AS-86B	Maryland St.	CS	600	Invert submerged 300 mm
SE-10	Rue Bourgeault	LDS	450	50 % submerged
SE-35	Avondale Rd.	LDS	750	Invert totally submerged
SE-40	Fernwood Ave.	LDS	750	Invert submerged 300 mm
SE-41	Clayton Dr.	LDS	525	Outlet totally submerged
SE-42	Berrydale Ave.	LDS	600	Invert submerged 300 mm
SE-44	Sadler Ave.	LDS	1066	Invert submerged 400 mm
SE-45	Hindley Ave.	LDS	530	Invert submerged 500 mm
SE-46	Worthington Ave.	LDS	750	Outlet totally submerged
SE-49	Willowlake Cres.	LDS	1050	Invert submerged. 600 mm
SE-50	N. of Beaverhill Blvd.	LDS	900	Outlet totally submerged
SE-52	Bishop Grandin Blvd.	LDS	800	Invert submerged 800 mm
SE-53.1	Royalwood Subdivision	LDS	450	Outlet submerged
BU-6.1	Delbrook Cres. 2	LDS	600	Outlet totally submerged
BU-7	Bonner Ave. 1	LDS	400	Outlet totally submerged
BU-8	Bonner Ave. 2	LDS	375	Outlet totally submerged
BU-16	Gateway Rd.	LDS	800	Outlet totally submerged in retention pond
BU-21	Sunny Hills Rd.	LDS	725	Outlet totally submerged in retention pond
BU-23	Mallows Way	LDS	900	Outlet totally submerged in retention pond
ST-1	Old Mill Rd.	LDS	400	Submerged
ST-7.1	Greenway Cres. 2	LDS	750	Invert submerged 300 mm
ST-18.1	Ness Ave.	LDS	400	Outlet totally submerged
ST-13	Alcott	WWS	600	50% sediment build-up in pipe

Outfalls > 1200 mm - Not Inspected

Outfall ID	Name	Type	Size	Comments
RR-14	SEWPCC Outfall	TS	1800	Will not be inspected internally
RR-16	Gateway Rd.	LDS	2280	Invert submerged 1000 mm
RR-32.5	Fermor Ave.	LDS	1950	Submerged
RR-39.7	St. Vital Bridge	LDS	1600	Outlet totally submerged
RR-47.1	Eccles St. at Churchill Dr.	LDS	1200	Invert submerged 800 mm and sediment build up at outlet
RR-47.5	Churchill High School	LDS	1600	Invert submerged 600 mm
RR-62	McDermot Ave.	CS	2700	Sediment build up
RR-64	Galt Ave. FPS	CS	1500	Invert submerged 1200 mm
RR-85	Inkster Blvd.	CS	2900	Invert submerged 1200 mm
RR-93	Rossmere Cres.	LDS	2900	Invert submerged 2000 mm
RR-99	NEWPCC Outfall Kildonan Golf Course	TS	3352x1200	Will not be inspected internally
RR-106	Summerview Lane	LDS	1800	Submerged
AS-1	WEWPCC Outfall	TS	1500	WEWPCC - Outfall will not be inspected internally
AS-24	Fairmont	LDS	2500	Invert submerged 1100 mm
AS-34	Olive St. 2	LDS	2200	Invert submerged 1100 mm
AS-59	Ferry Rd.	CS	1800	Invert submerged 600 mm and gate chamber bolted shut
AS-72	Renfrew St.	LDS	2400	Invert submerged 1200 mm
AS-77	Ash St.	CS	3048	Invert submerged 800 mm
AS-79	Aubrey St.	CS	2900x2300	Invert submerged
AS-82	Ruby St. 2	CS	2700	Invert submerged and MH locked
AS-85	Canora St.	CS	1980	Invert submerged and MH locked
AS-89	Spence St.	CS	2700	Outlet totally submerged
AS-92	Fort Rouge Park	CS	2400	Invert submerged 1200 mm
AS-97	The Forks E. of C.N.R. Bridge	LDS	1200	Invert submerged 600 mm and sediment build up
AS-99	Mayfair Ave.	WWS	1200	Invert submerged 600 mm
SE-48	Willowlake Cres.	LDS	1525	Outlet totally submerged
SE-51	Lavelee Rd.	LDS	1220	Invert submerged 800 mm
SE-53	Richfield Ave.	LDS	1200	Invert submerged 600 mm
SE-54	Public Lane E. of Meadowood Dr.	LDS	1200	Invert submerged 800 mm
SE-55	N. of John Bruce Rd.	LDS	1200	Invert submerged 600 mm
SE-56	Woodydell	LDS	1200	Invert submerged 1000 mm
SE-57	Compark	LDS	1400	Invert submerged 1000 mm
SE-58	Southglen	LDS	1600	Invert submerged 800 mm
SE-58.1	St. Annes Rd.	LDS	2-1600x1120	Invert submerged 1000 mm
BU-4	Rothesay St. N.	LDS	1200	Invert submerged 600 mm
BU-5	Rothesay St. S.	LDS	1200	Invert submerged 600 mm
BU-18	Jim Smith Dr.	LDS	1390x970	Outlet totally submerged in retention pond
BU-20	Sun Valley Dr.	LDS	1800	Outlet totally submerged in retention pond
BU-22	Wpg. Hydro Transmission Line	LDS	2125	Outlet totally submerged in retention pond
ST-4	Sturgeon Rd. (north)	LDS	1500	Invert submerged 750 mm & bank collapsed
ST-5	Sturgeon Rd. (south)	LDS	1200	Outlet totally submerged
ST-14	Ness Ave.	LDS	1900	Invert submerged 950 mm
OM-2	Clifton St. Overflow	CS	2700	Inv. sub. 800 mm

APPENDIX F
Outfall Inspection
Video Tape Index

APPENDIX F

OUTFALL INSPECTION VIDEO TAPE INDEX

ASSINIBOINE RIVER

Name	Outfall ID	Type	Size	Tape	Count
Arbuthnot	AS-87	CS	1400	3	1:20:10 - 1:27:30
Arlington St. 1	AS-83	CS	375	11	1:08:06 - 1:14:56
Ash St FPS	AS-76	CS	2100	3	1:51:01 - 2:00:42
Assiniboine Ave. - FPD	AS-95	CS	1350	6	2:14:43 - 2:27:56
				7	0:00:00 - 0:03:59
Aubrey St. FPS	AS-80	CS	2850	4	0:18:25 - 0:24:28
Barker Bvld.	AS-11	LDS	1075	14	0:26:06 - 0:27:34
Carroll Rd.	AS-19	LDS	1800	8	0:37:10 - 0:44:00
Chataway Blvd.	AS-60	CS	900	14	0:27:35 - 0:31:12
Chataway Blvd. 2	AS-60B	LDS	600		Visual
Clifton St.	AS-75	CS	2300	4	0:24:28 - 0:32:08
Clifton St. FPD	AS-74	CS	2100	8	1:47:22 - 1:55:59
Coleridge Park Dr. South	AS-14	LDS	450	11	0:19:28 - 0:25:03
Colony St.	AS-90	CS	1800	7	0:04:02 - 0:15:50
Conway CS	AS-42	CS	2500	4	0:44:27 - 0:57:20
Cornish Ave FPS	AS-86	CS	1600	7	0:38:37 - 0:57:25
Cornish St. 2	AS-88	CS	1500	7	0:22:45 - 0:38:37
Country Club Blvd.	AS-28	LDS	900	11	0:33:08 - 0:40:55
Dieppe Rd.	AS-23	WWS	650	12	1:02:53 - 1:04:00
Dieppe Rd. 2	AS-23.1	WWS	900	17	0:04:58 - 0:10:01
Donald St.	AS-94	CS	1900	2	1:17:10 - 1:25:34
Doncaster St.	AS-61	CS	2250	3	1:27:38 - 1:36:24
Douglas Park Rd.	AS-57	CS	300	11	0:47:09 - 0:47:42
Edgeland Blvd.	AS-61A	LDS	400	14	0:42:38 - 0:43:55
Elm St.	AS-78	CS	762	12	1:04:00 - 1:11:58
Empress Street	AS-70	LDS	300	11	0:52:06 - 1:00:11
Empress Street 2	AS-71	LDS	300	11	1:00:11 - 1:08:06
Glasworthy Pl.	AS-12	LDS	450	11	0:14:21 - 0:19:38
Hargrave St.	AS-93	CS	700	11	1:23:07 - 1:30:40
Harstone Rd.	AS-22	LDS	450	12	0:53:42 - 1:02:53
Kennedy St.	AS-91	CS	760	11	1:14:56 - 1:23:07
King Edward St.	AS-66	LDS	650	14	0:31:13 - 0:34:09
Landoo Dr.	AS-21.5	LDS	900	12	0:49:13 - 0:53:42
				12	1:11:58 - 1:16:08
McCallum Cres.	AS-18	LDS	1350	3	1:43:13 - 1:51:00
Olive St.	AS-33	CS	750	11	0:40:55 - 0:47:09
Orchard Park	AS-16.5	LDS	600	12	0:40:32 - 0:49:13
P.T.H. 100 E. Side	AS-4	LDS	800	14	0:17:35 - 0:24:26
P.T.H. 100 E. Side	AS-5	LDS	1200	1	0:12:20 - 0:25:58
P.T.H. 100 E. Side	AS-5.1	LDS	1500	1	0:12:20 - 0:25:58
P.T.H. 100 W. Side	AS-2	LDS	1400	4	1:01:39 - 1:05:52
P.T.H. 100 W. Side	AS-3	LDS	1200	1	0:06:00 - 0:12:20
Paradise Bay	AS-15	LDS	600	12	0:33:19 - 0:40:32
Park Bvld.	AS-58	LDS	2400	8	0:16:02 - 0:21:15
Parkside Dr.	AS-62	CS	750	11	0:47:42 - 0:52:06
				11	1:30:40 - 1:39:11

ASSINIBOINE RIVER

Name	Outfall ID	Type	Size	Tape	Count
Pender St.	AS-10	LDS	900	14	0:24:27 - 0:26:05
Raquette St. 2	AS-16.1	LDS	1800	8	1:55:59 - 2:07:26
Ridgedale Cres.	AS-27	LDS	450	12	0:05:04 - 0:12:34
Ridgedale S.P.S.	AS-26	WWS	250	12	0:17:59 - 0:25:55
Riverbend Cres.	AS-63	CS	2340	8	0:07:15 - 0:15:55
Route 90 Bridge	AS-67A	LDS	450	14	0:40:14 - 0:42:37
Ruby St. 1	AS-81	CS	2100	8	1:11:02 - 1:20:48
Sheir Dr.	AS-9.9	WWS	250	12	0:25:55 - 0:33:19
Shenfield Rd.	AS-25	LDS	450	12	0:12:34 - 0:17:59
St. Charles St. 1	AS-8	WWS	250	11	0:00:00 - 0:08:13
St. Charles St. 2	AS-9	LDS	900	11	0:08:14 - 0:14:21
St. James Underpass	AS-65	LDS	900	11	1:48:09 - end
Strathmillan Rd.	AS-37	CS	900	11	1:39:11 - 1:48:09
Tylehurst St.	AS-69	CS	2300	4	0:32:26 - 0:38:48
Vialoux Dr.	AS-35	LDS	1500	3	1:36:24 - 1:43:13
Vialoux Dr. Cul-de-Sac	AS-38	LDS	750	12	0:00:00 - 0:05:04
Wellington Cres. 2	AS-66.8	LDS	450	14	0:38:42 - 0:40:13
Wellington Cresc.	AS-68	LDS	500	16	0:00:00 - 0:08:52
WEWPCC Outfall	AS-1	TS	1500	1	0:00:00 - 0:06:00
Willow Ridge Rd.	AS-13	LDS	1800	3	2:04:06 - 2:19:41
Woodhaven Blvd.	AS-29	CS	450	11	0:25:08 - 0:33:08

RED RIVER

Name	Outfall ID	Type	Size	Tape	Count
Archibald Underpass	RR-68	LDS	750	10	1:04:38 - 1:08:58
				16	0:51:50 - 0:54:45
Armstrong Ave.	RR-95	CS	2700	3	0:20:36 - 0:26:12
Baltimore St. FPS	RR-45	CS	1800	8	0:44:17 - 0:51:51
Bannatyne Ave.	RR-63	CS	1500	16	0:47:47 - 0:51:49
Banning Rd.	RR-19	LDS	1370	2	0:38:56 - 0:44:17
Bishop Grandin Blvd. 2	RR-21	LDS	750	16	0:15:21 - 0:19:00
Bredin Dr.	RR-82	LDS	450	9	0:18:49 - 0:25:01
Burrows Ave.	RR-76	CS	2400		not televised
Calrossie Blvd.	RR-37	CS	450	10	0:17:15 - 0:21:12
Chelsea Pl	RR-87	LDS	2260	8	1:01:01 - 1:09:14
Churchill Dr. Underpass	RR-41	LDS	800	10	0:10:37 - 0:17:15
Cockburn St. FPS	RR-38	CS	1500	2	0:54:46 - 1:05:19
Cockburn St. Lift Station Outfall	RR-39	CS	1800	1	0:55:19 - 1:03:10
Crane Ave.	RR-26	CS	600	9	0:39:31 - 0:46:45
Crane Ave. Outfall	RR-27	CS	900	9	0:32:26 - 0:39:31
Darcy Dr.	RR-20	CS	2200	2	0:44:19 - 0:54:46
Disraeli Bridge	RR-73	LDS	300	9	0:15:49 - 0:17:39
Dowker Ave. Outfall	RR-28	LDS	900	10	0:55:15 - 1:04:38
Dunham Rd. Outfall	RR-33	LDS	1200	16	0:54:46 - 1:01:16
Dunkirk Dr.	RR-31	LDS	1400	2	0:15:26 - 0:24:31
Eastwood Dr.	RR-108	LDS	525	10	1:22:43 - 1:32:25
Edinburgh St.	RR-42	CS	800	10	0:07:02 - 0:10:37
Falconer Bay	RR-24	LDS	1200	6	0:29:57 - 0:38:33
				15	0:00:00 - 0:09:29
Glasgow Ave.	RR-48	LDS	1200	3	0:35:30 - 0:40:23
Glenview Ave.	RR-32	LDS	525	10	0:00:00 - 0:05:11
Grandmont Blvd.	RR-6	WWS	750	16	0:34:14 - 0:47:46
Hart Ave.	RR-79	CS	2850	6	0:47:13 - 0:58:14
				8	0:51:51 - 1:00:49
Hawthorne Ave.	RR-98	CS	2200	2	1:05:19 - 1:17:10
Henderson Hwy. (Private)	RR-105	LDS	600	10	1:19:20 - 1:22:43
Jefferson Ave.	RR-88	CS	3300	5	1:10:42 - 1:20:22
Jessie Ave	RR-49	CS	1900	7	1:04:09 - 1:14:40
John Black Ave.	RR-101	LDS	1800		not televised
Kildonan Park #1	RR-97	LDS	250	9	0:17:39 - 0:18:49
Killarney St.	RR-43	LDS	1200	7	0:57:25 - 1:04:09
				10	0:31:34 - 0:37:13
Kings Dr.	RR-12	LDS	1500	5	1:36:12 - 1:45:41
Kingston Row Underpass	RR-40	LDS	750	10	0:05:11 - 0:07:02
Larchdale Cres. SPS	RR-96	LDS	1050	10	1:14:24 - 1:19:20
Lemay Ave.	RR-2	LDS	900	9	0:25:01 - 0:29:30
Linden Ave.	RR-90	CS	1800	5	0:00:03 - 0:33:32
Linden Ave. - Flood Pump Discharge	RR-91	CS	1675	5	0:33:32 - 0:54:57
Lotus Lane	RR-30	LDS	600	10	0:21:12 - 0:31:34
Mager St. FPS	RR-44	LDS	1800	6	1:23:37 - 1:39:56

RED RIVER

Name	Outfall ID	Type	Size	Tape	Count
Marion St. 2	RR-52	CS	1800	1	0:26:13 - 0:55:13
Marion St. FPD	RR-51	CS	1600	1	0:26:13 - 0:55:13
Metcalfe Pl.	RR-46	CS	2000	6	1:13:43 - 1:23:29
Minnetonka	RR-17	LDS	2100	6	0:12:15 - 0:29:57
Moore Ave.	RR-25	LDS	1100	6	0:38:33 - 0:47:00
Munroe Ave. FPS	RR-84	CS	2500	4	1:05:56 - 1:09:04
Newton Ave.	RR-94	CS	1850	5	1:20:22 - 1:27:00
Oakcrest Pl.	RR-34	LDS	375	10	0:37:13 - 0:45:05
Park Dr.	RR-50.5	LDS	1200	16	1:10:53 - 1:20:13
Perimeter Hwy. at Cloutier Dr.	RR-7	CS	1800	3	0:00:00 - 0:20:36
Plaza Dr.	RR-22	LDS	2400	5	1:27:03 - 1:36:11
Polson Ave. FPS	RR-83	CS	1800	3	0:26:15 - 0:35:28
Pritchard Ave.	RR-75	CS	250	9	0:00:00 - 0:11:45
Radcliffe 1	RR-10	LDS	1200	3	1:07:58 - 1:20:00
Red River Blvd.	RR-104	LDS	750	10	1:32:25 - 1:50:21
Rice Dr.	RR-9	LDS	1500	5	1:45:43 - 2:03:29
River Pointe Pl.	RR-18	LDS	1050	16	0:24:00 - 0:30:51
Riverdale Ave.	RR-34.8	LDS	600	16	0:19:01 - 0:23:59
Rivergate Dr.	RR-15	WWS	1350	2	0:30:06 - 0:38:52
Riviera Cres. Outfall	RR-23	LDS	2000	3	0:56:06 - 1:07:58
Rue Despins	RR-54	CS	1400	6	1:39:56 - 1:51:06
Rue Despins FPD	RR-55	CS	1200	1	1:09:40 - 1:27:36
Rue Dumoulin 2	RR-57	CS	1200	1	1:30:57 - 1:49:04
Rue Dumoulin 3	RR-58	CS	1060	9	0:11:45 - 0:15:49
				6	1:51:09 - 2:07:56
Rue La Verendrye	RR-59	CS	1200	8	1:20:48 - 1:30:02
Rue La Verendrye FPS	RR-60	CS	600	10	1:08:58 - 1:14:24
Selkirk Ave.	RR-74	CS	1800	5	1:00:18 - 1:10:42
Somerset Ave.	RR-36	CS	1800	3	0:40:23 - 0:56:06
St. John's Park MH	RR-80	CS	3000	7	1:34:38 - 1:42:38
St. Norbert X-Kalay Lift Station Overflow	RR-3	WWS	300	9	0:29:30 - 0:32:26
Stormont Dr.	RR-8	LDS	400	16	0:30:52 - 0:34:13
Syndicate St. - Flood Pump Discharge	RR-71	CS	1800	2	0:07:32 - 0:15:25
Valhalla Dr.	RR-103	LDS	1675	6	0:58:14 - 1:13:43
Watt St.	RR-70	CS	3700	7	1:16:03 - 1:34:38
Watt St. 2 (connector pipe)	RR-70.1	CS	1500	7	1:16:03 - 1:34:38
Watt St. 3 (connector pipe)	RR-70.2	CS	1850	7	1:16:03 - 1:34:38
Watt St. 4 (connector pipe)	RR-70.3	CS	1250	7	1:16:03 - 1:34:38
Whellams Lane	RR-100	WWS	1200	6	0:05:48 - 0:12:07
Wildwood Golf Coarse	RR-35	CS	900	10	0:45:05 - 0:55:15

SEINE RIVER

Name	Outfall ID	Type	Size	Tape	Count
Blenheim Ave.	SE-31	LDS	1060	13	0:08:49 - 0:10:30
Comanche Rd.	SE-36	WWS	600	13	1:59:16 - 2:00:37
Cote St.	SE-28	WWS	450	13	0:25:09 - 0:33:03
Egerton Rd.	SE-30.1	LDS	900	13	0:10:31 - 0:13:36
Evans Ave.	SE-27	LDS	1067	13	0:20:51 - 0:22:55
Fermor Ave.	SE-37	LDS	600	13	0:15:03 - 0:16:27
Gareau St.	SE-29	LDS	800	13	0:18:44 - 0:20:50
Guay Ave.	SE-30	LDS	750	13	0:13:37 - 0:15:02
Humbolt Ave.	SE-33	LDS	900	13	0:02:44 - 0:06:00
Imperial Ave.	SE-32	LDS	750	13	0:06:01 - 0:08:48
Kavanagh St.	SE-12	LDS	750	13	0:33:04 - 0:36:14
Marlene St.	SE-47	LDS	530	14	0:00:00 - 0:02:28
Mission FPS	SE-1	CS	2600	3	2:19:45 - 2:32:51
Morrow Ave.	SE-39	LDS	750	18	0:00:00 - end
Niakwa Rd. 1	SE-38	LDS	450	13	0:00:00 - 0:02:43
Niakwa Rd. 2	SE-38.1	LDS	450	17	0:23:21 - 0:27:35
Rue Archibald St.	SE-34	LDS	2700	8	2:07:26 - 2:18:40
Rue Dumoulin	SE-5	WWS	600	14	0:02:29 - 0:04:49
Rue Laverendrye	SE-2	LDS	600	14	0:04:50 - 0:06:01
Rue Notre Dame W.	SE-4	LDS	1220	17	0:15:26 - 0:23:20
Southbridge Dr.	SE-43	LDS	900	13	0:16:28 - 0:18:43
St. Catherine St. 1	SE-21	LDS	600	13	0:22:56 - 0:25:08

BUNNS CREEK

Name	Outfall ID	Type	Size	Tape	Count
Bonner Ave.	BU-3	LDS	525	13	0:41:26 - 0:43:08
Delbrook Cres.	BU-6	LDS	400	16	1:01:17 - 1:02:57
Henderson Hwy.	BU-1	LDS	1375	3	2:34:33 - 2:44:00
Henderson Hwy. 2	BU-2	LDS	1200	3	2:44:00 - 2:53:10
McIvor Ave.	BU-12	LDS	400	13	0:36:15 - 0:37:37
Pennefather St.	BU-9	LDS	1350	17	0:10:02 - 0:15:25
Raleigh St. 1	BU-13	LDS	400	13	1:48:20 - 1:49:40
Raleigh St. 2	BU-14	LDS	750	13	0:39:55 - 0:41:25
Raleigh St. 3	BU-15	LDS	750	13	1:49:41 - 1:59:15
Uxbridge Rd. N.	BU-10	LDS	1200	2	0:00:00 - 0:05:27
Uxbridge Rd. S.	BU-11	LDS	900	13	0:37:38 - 0:39:54

OMAND'S CREEK

Name	Outfall ID	Type	Size	Tape	Count
Empress St. 1	OM-3	LDS	750	16	1:02:58 - 1:09:42
Raglan Rd.	OM-1	LDS	400	14	0:43:56 - 0:46:41
Velodrome 1	OM-4	LDS	380	16	1:09:43 - 1:10:52

STURGEON CREEK

Name	Outfall ID	Type	Size	Tape	Count
Acheson Dr.	ST-23	LDS	900	13	1:35:07 - 1:43:28
Amarynth Cres.	ST-9	LDS	525	13	0:56:47 - 1:03:00
Amarynth Cres. 2	ST-12	LDS	400	13	1:03:01 - 1:04:57
Booth Dr.	ST-3	LDS	1850	8	0:28:48 - 0:36:53
Crestview Park Dr.	ST-22	LDS	762	13	1:31:54 - 1:33:31
Crestview Park Dr. (pond drainage)	ST-21	LDS	1676	8	0:00:15 - 0:07:11
Greenway Cres.	ST-7	LDS	600	14	0:10:52 - 0:17:34
Hamilton Ave.	ST-18	LDS	1500	8	0:23:18 - 0:28:48
Harvest Lane	ST-17	LDS	400	13	1:12:06 - 1:17:41
Kirby Dr.	ST-11	LDS	600	13	1:04:58 - 1:07:05
Lonsdale Dr.	ST-8	LDS	600	13	0:51:02 - 0:56:46
Saskatchewan Ave.	ST-24	LDS	361	13	1:33:32 - 1:35:06
Setter St.	ST-6	LDS	600	13	0:43:09 - 0:51:01
Silver Ave.	ST-19	WWS	525	13	1:17:42 - 1:30:04
Valleyview Dr. 1	ST-15	WWS	600	13	1:07:06 - 1:10:46
Valleyview Dr. 2	ST-16	LDS	1050	13	1:43:29 - 1:48:19
Voyageur	ST-20	WWS	600	13	1:30:05 - 1:31:53

LaSALLE RIVER

Name	Outfall ID	Type	Size	Tape	Count
La Maire Ave.	LS-4	LDS	1000	16	0:12:02 - 0:15:20
Rue Des Trappistes	LS-2	LDS	450	14	0:06:02 - 0:10:51

FLOODWAY

Name	Outfall ID	Type	Size	Tape	Count
Deacon Reservoir	FL-1	LDS	1500	8	1:30:02 - 1:38:32
Kildare at Floodway	FL-2	LDS	3000	8	1:38:34 - 1:47:13

APPENDIX G
Detail Cost
Estimate

Outfall ID#	NAME	Pipe size (mm)	Access	Pipe Length - Concrete Pipe (m)	Pipe Length - CMP (m)	Pipe Cost - Concrete Pipe ($/m)[1]	Total Concrete Pipe cost	Pipe Cost - CMP ($/m)[1]	Total CMP cost	Surface Condition	Restoration	Sub-Total	Engineering 14%	Overhead 7%	Contingencies 10%	Total Estimated Cost For Pipe Repairs	Total Estimated Cost For Erosion Protection	Total Estimated Cost	Comments
Pumping Stations and Flood Pumping Stations																			
AS 74	Clifton Street FPD	2100	$ 7,500		35	$2,410	$ -	$1,060	$ 37,100	sod	$ 3,000	$ 47,600	$ 6,664	$ 3,332	$ 4,760	$ 62,000	$ 10,000	$ 72,000	Requires Rip Rap
RR 51	Marion Street FPD	1600	$ 5,000		34			$830	$ 28,220	sod	$ 3,000	$ 36,220	$ 5,071	$ 2,535	$ 3,622	$ 47,000	$ 10,000	$ 57,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 55	Rue Despins FPD	1200	$ 5,000		34			$600	$ 20,400	sod	$ 3,000	$ 28,400	$ 3,976	$ 1,988	$ 2,840	$ 37,000	$ 10,000	$ 47,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 60	Rue La Verendrye	600	$ 5,000		8	$190	$ -	$170	$ 1,360	scrub grass	$ 1,000	$ 7,360	$ 1,030	$ 515	$ 736	$ 10,000	$ 25,000	$ 35,000	"Spot" repair 5 m; Pipe has shifted. Requires Rip Rap
	Subtotal															$ 156,000	$ 55,000	$ 211,000	
Waste Water Sewer Overflow																			
RR 100	Whellams Lane	1200	$ 7,500			$770	$ -	$600	$ -	scrub		$ 7,500	$ 1,050	$ 525	$ 750	$ 10,000	$ 10,000	$ 20,000	Requires Rip Rap
AS 23	Dieppe Road	650	$ 5,000			$190	$ -	$170	$ -	sod		$ 5,000	$ 700	$ 350	$ 500	$ 7,000	$ 5,000	$ 12,000	Incomplete inspection another cmp runs through pipe. Requires Rip Rap
RR 3	St. Norbert X-Kalay Lift Station Overflow	300	$ 7,500	20	5	$90	$ 1,800	$75	$ 375	trees and bush	$ 1,500	$ 11,175	$ 1,565	$ 782	$ 1,118	$ 15,000	$ 10,000	$ 25,000	Requires Rip Rap
AS 9.9	Sheir Dr.	250			47.5	$50	$ -	$60	$ 2,850	assume sod	$ 2,500	$ 5,350	$ 749	$ 375	$ 535	$ 7,000		$ 7,000	
AS 26	Ridgedale S.P.S.	250	$ 5,000		10	$50	$ -	$60	$ 600	assume sod	$ 2,500	$ 8,100	$ 1,134	$ 567	$ 810	$ 11,000		$ 11,000	"Spot" repair 10 m; Side of CMP pushed in
AS 8	St. Charles Street 1	250		70.7		$50	$ 3,535			assume sod	$ 2,500	$ 6,035	$ 845	$ 422	$ 604	$ 8,000		$ 8,000	
	Subtotal															$ 58,000	$ 25,000	$ 83,000	
Combined Sewer Overflow																			
RR 79	Hart Ave	2850	$ 5,000		37	$4,200	$ -	$1,430	$ 52,910	trees and bush	$ 1,500	$ 59,410	$ 8,317	$ 4,159	$ 5,941	$ 78,000	$ 25,000	$ 103,000	Requires Rip Rap
AS 42	Conway CS	2500	$ 5,000	62.5	15	$3,060	$ 191,250	$1,280	$ 19,200	sod		$ 215,450	$30,163	$ 15,082	$ 21,545	$ 282,000	$ 50,000	$ 332,000	Requires Rip Rap
AS 61	Doncastor Street	2250	$ 5,000	40	5	$2,410	$ 96,400	$1,180	$ 5,900	assume sod	$ 3,500	$ 110,800	$15,512	$ 7,756	$ 11,080	$ 145,000	$ 25,000	$ 170,000	Requires Rip Rap
AS 81	Ruby St. 1	2100	$ 5,000		30	$2,410	$ -	$1,060	$ 31,800	sod	$ 2,500	$ 39,300	$ 5,502	$ 2,751	$ 3,930	$ 51,000	$ 10,000	$ 61,000	Requires Rip Rap
AS 90	Colony Street	1800	$ 5,000	22	15	$1,680	$ 36,960	$930	$ 13,950	sod	$ 1,875	$ 57,785	$ 8,090	$ 4,045	$ 5,779	$ 76,000	$ 25,000	$ 101,000	Requires Rip Rap
RR 52	Marion Street	1800	$ 5,000		41			$930	$ 38,130	sod	$ 2,500	$ 45,630	$ 6,388	$ 3,194	$ 4,563	$ 60,000	$ 10,000	$ 70,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 90	Linden Ave.	1800	$ 5,000	10		$1,680	$ 16,800	$930	$ -	scrub grass	$ 1,000	$ 22,800	$ 3,192	$ 1,596	$ 2,280	$ 30,000	$ 5,000	$ 35,000	Requires Rip Rap
RR 54	Rue Despins	1400		13	22	$970	$ 12,610	$730	$ 16,060	sod	$ 2,500	$ 31,170	$ 4,364	$ 2,182	$ 3,117	$ 41,000	$ 5,000	$ 46,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 58	Rue Doumoulin	1060	$ 5,000		37	$590	$ -	$380	$ 14,060	sod	$ 3,000	$ 22,060	$ 3,088	$ 1,544	$ 2,206	$ 29,000	$ 5,000	$ 34,000	Replacement cost only. Pricing is subject to replacement as part of the Future Provencher Bridge project. Requires Rip Rap
RR 96	Larchdale Cres. SPS	1050	$ 5,000	12	3	$590	$ 7,080	$380	$ 1,140	scrub grass	$ 1,000	$ 14,220	$ 1,991	$ 995	$ 1,422	$ 19,000	$ 10,000	$ 29,000	Requires Rip Rap
AS 37	Strathmillan Road	900	$ 5,000	15	15	$410	$ 6,150	$250	$ 3,750	sod	$ 2,500	$ 17,400	$ 2,436	$ 1,218	$ 1,740	$ 23,000	$ 25,000	$ 48,000	Outfall is Submerged. Requires Rip Rap
AS 91	Kennedy Street	760	$ 15,000	10	10	$250	$ 2,500	$210	$ 2,100	riverwalk and rip rap	$ 7,500	$ 27,100	$ 3,794	$ 1,897	$ 2,710	$ 36,000		$ 36,000	
AS 93	Hargrave Street	700	$ 15,000		5	$190	$ -	$170	$ 850	rip rap	$ 2,500	$ 18,350	$ 2,569	$ 1,285	$ 1,835	$ 24,000		$ 24,000	"Spot" repair 5 m; Pipe has shifted
AS 29	Woodhaven Blvd.	450	$ 15,000	70		$140	$ 9,800	$100	$ -	sod	$ 4,000	$ 28,800	$ 4,032	$ 2,016	$ 2,880	$ 38,000	$ 5,000	$ 43,000	Requires Rip Rap
RR 37	Calrossie Blvd	450	$ 7,500		20	$140	$ -	$100	$ 2,000	scrub grass	$ 1,000	$ 10,500	$ 1,470	$ 735	$ 1,050	$ 14,000	$ 10,000	$ 24,000	Requires Rip Rap
AS 83	Arlington Street 1	375	$ 5,000		35	$100	$ -	$75	$ 2,625	scrub grass	$ 1,500	$ 9,125	$ 1,278	$ 639	$ 913	$ 12,000		$ 12,000	Includes an extra 15m section to extend outfall into the river
	Subtotal															$ 958,000	$ 210,000	$ 1,168,000	
Land Drainage Sewer																			
FL 2	Kildare at Floodway	3000	$ 5,000	45		$4,200	$ 189,000	$1,600	$ -	scrub grass	$ 2,000	$ 196,000	$27,440	$ 13,720	$ 19,600	$ 257,000	$ 25,000	$ 282,000	Requires Rip Rap
ST 3	Booth Drive	1850	$ 5,000	5	7	$1,680	$ 8,400	$930	$ 6,510	sod	$ 1,500	$ 21,410	$ 2,997	$ 1,499	$ 2,141	$ 28,000	$ 5,000	$ 33,000	Requires Rip Rap
AS 16.1	Requette street 2	1800	$ 5,000	20		$1,680	$ 33,600	$930	$ -	sod		$ 38,600	$ 5,404	$ 2,702	$ 3,860	$ 51,000	$ 5,000	$ 56,000	Requires Rip Rap
AS 19	Carroll Road	1800	$ 5,000		75	$1,680	$ -	$930	$ 69,750	sod	$ 5,250	$ 80,000	$11,200	$ 5,600	$ 8,000	$ 105,000	$ 30,000	$ 135,000	Requires Rip Rap
RR 7	Cloutier Drive (Segment 1 & 2)	1800/900	$ 5,000		5/40		$ -	$930/$600	$ 28,650	trees and bush	$ 3,000	$ 36,650	$ 5,131	$ 2,566	$ 3,665	$ 48,000	$ 10,000	$ 58,000	"Spot" repair 5 m on Segment 1. Requires Rip Rap Repairs
RR 103	Valhalla Drive	1675	$ 10,000		25	$1,400	$ -	$830	$ 20,750	asphalt parking lot	$ 7,500	$ 38,250	$ 5,355	$ 2,678	$ 3,825	$ 50,000	$ 10,000	$ 60,000	Requires Rip Rap
FL 1	Deacon Reservoir	1500	$ 5,000			$1,170	$ 15,000	$730	$ -	scrub grass	$ 2,000	$ 22,000	$ 3,080	$ 1,540	$ 2,200	$ 29,000		$ 29,000	Majority of the joints have started to separate, some > 25mm, Assume $15,000 to grout shifted joints
RR 31	Dunkirk Drive	1400	$ 5,000		15	$970	$ -	$730	$ 10,950	grass	$ 1,500	$ 17,450	$ 2,443	$ 1,222	$ 1,745	$ 23,000	$ 20,000	$ 43,000	Requires Rip Rap
AS 18	McCallum Cres.	1350	$ 5,000		5	$970	$ -	$600	$ 3,000	sod	$ 1,500	$ 9,500	$ 1,330	$ 665	$ 950	$ 12,000		$ 12,000	"Spot" repair 5 m; Outlet is damaged
RR 59	Rue La Verendrye	1200	$ 5,000	25	2	$770	$ 19,250	$600	$ 1,200	scrub and bush	$ 1,000	$ 26,450	$ 3,703	$ 1,852	$ 2,645	$ 35,000	$ 25,000	$ 60,000	Requires Rip Rap
AS 10	Pender Street	900	$ 5,000		5	$410	$ -	$250	$ 1,250	trees and scrub grass	$ 3,000	$ 9,250	$ 1,295	$ 648	$ 925	$ 12,000		$ 12,000	"Spot" repair 5 m; Pipe outlet has some ice damage
RR 28	Dowker Ave. Outfall	900	$ 7,500		6	$410	$ -	$250	$ 1,500	trees and brush	$ 1,000	$ 10,000	$ 1,400	$ 700	$ 1,000	$ 13,000	$ 10,000	$ 23,000	Requires Rip Rap
RR 68	Archibald Underpass	750	$ 15,000	5		$250	$ 1,250	$210	$ -	scrub grass	$ 1,000	$ 17,250	$ 2,415	$ 1,208	$ 1,725	$ 23,000		$ 23,000	"Spot" repair 5 m; Pipe has shifted; Outfall is Submerged
AS 38	Vialoux Drive Cul-de-Sac	750	$ 15,000	20		$250	$ 5,000	$210	$ -	scrub grass	$ 1,500	$ 21,500	$ 3,010	$ 1,505	$ 2,150	$ 28,000		$ 28,000	
OM 3	Empress Street 1	750	$ 5,000	45		$250	$ 11,250	$210	$ -	scrub grass	$ 2,000	$ 18,250	$ 2,555	$ 1,278	$ 1,825	$ 24,000		$ 24,000	
RR 104	Red River Blvd.	750	$ 5,000	50	31	$250	$ 12,500	$210	$ 6,510	scrub grass	$ 2,000	$ 26,010	$ 3,641	$ 1,821	$ 2,601	$ 34,000		$ 34,000	
RR 30	Lotus lane	600	$ 5,000		11	$190	$ -	$170	$ 1,870	scrub grass	$ 1,000	$ 7,870	$ 1,102	$ 551	$ 787	$ 10,000	$ 10,000	$ 20,000	Requires Rip Rap
SE 2	Rue Laverendrye	600	$ 5,000		5	$190	$ -	$170	$ 850	trees and bush	$ 1,000	$ 6,850	$ 959	$ 480	$ 685	$ 9,000		$ 9,000	"Spot" repair 5 m; Pipe has shifted
RR 41	Churchill Drive Underpass	525	$ 7,500	15		$190	$ 2,850	$100	$ -	sod		$ 10,350	$ 1,449	$ 725	$ 1,035	$ 14,000	$ 5,000	$ 19,000	Incomplete inspection too much sediment build-up. Requires Rip Rap
RR 108	Eastwood Drive	525	$ 10,000	46	10	$190	$ 8,740	$100	$ 1,000	scrub grass	$ 2,000	$ 21,740	$ 3,044	$ 1,522	$ 2,174	$ 28,000	$ 25,000	$ 53,000	Requires Rip Rap
AS 25	Shenfield Road	450	$ 15,000		50	$140	$ -	$100	$ 5,000	trees and bush	$ 1,500	$ 21,500	$ 3,010	$ 1,505	$ 2,150	$ 28,000	$ 5,000	$ 33,000	Requires Rip Rap
AS 27	Ridgedale Cres	450	$ 5,000	7	25	$140	$ 980	$100	$ 2,500	trees and bush	$ 1,000	$ 9,480	$ 1,327	$ 664	$ 948	$ 12,000		$ 12,000	
BU 6	Delbrook Cres.	400	$ 5,000		17	$100	$ -	$100	$ 1,700	sod	$ 1,500	$ 8,200	$ 1,148	$ 574	$ 820	$ 11,000		$ 11,000	Pipe collapsed incomplete inspection.
RR 8	Stormont Drive	400	$ 5,000		10	$100	$ -	$100	$ 1,000	scrub grass	$ 1,000	$ 7,000	$ 980	$ 490	$ 700	$ 9,000	$ 10,000	$ 19,000	Requires Rip Rap
ST 12	Amarynth Cres. 2	400	$ 10,000			$100	$ -	$100	$ -	sod		$ 10,000	$ 1,400	$ 700	$ 1,000	$ 13,000		$ 13,000	
ST 17	Harvest Lane	400	$ 10,000		16	$100	$ -	$100	$ 1,600	sod	$ 1,500	$ 13,100	$ 1,834	$ 917	$ 1,310	$ 17,000	$ 5,000	$ 22,000	Requires Rip Rap
OM 4	Velodrome 1	380	$ 5,000		6.1	$100	$ -	$75	$ 458	scrub grass	$ 1,000	$ 6,458	$ 904	$ 452	$ 646	$ 8,000	$ 25,000	$ 33,000	Pipe collapsed incomplete inspection. Requires Rip Rap
RR 34	Oakcrest Place	375	$ 7,500	37	20	$100	$ 3,700	$75	$ 1,500	scrub	$ 1,750	$ 14,450	$ 2,023	$ 1,012	$ 1,445	$ 19,000	$ 50,000	$ 69,000	Requires Rip Rap
AS 70	Empress Street	300	$ 10,000		10	$90	$ -	$75	$ 750	sod	$ 1,500	$ 12,250	$ 1,715	$ 858	$ 1,225	$ 16,000		$ 16,000	
	Subtotal															$ 966,000	$ 275,000	$ 1,241,000	
	TOTAL															$ 2,138,000	$ 565,000	$ 2,703,000	

APPENDIX G

DETAIL COST ESTIMATES
CAPITAL UPGRADES AND
ICE DAMAGE MAINTENANCE

Outfall ID#	NAME	Pipe si (mm)	al ated For ion :tion	Total Estimated Cost	Comments
Pumping Stations and Flood Pumping Stations					
AS 74	Clifton Street FPD	2100	0,000	$ 72,000	Requires Rip Rap
RR 51	Marion Street FPD	1600	0,000	$ 57,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 55	Rue Despins FPD	1200	0,000	$ 47,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 60	Rue La Verendrye	600	5,000	$ 35,000	"Spot" repair 5 m; Pipe has shifted. Requires Rip Rap
	Subtotal		5,000	$ 211,000	
Waste Water Sewer Overflow					
RR 100	Whellams Lane	1200	0,000	$ 20,000	Requires Rip Rap
AS 23	Dieppe Road	650	5,000	$ 12,000	Incomplete inspection another cmp runs through pipe. Requires Rip Rap
RR 3	St. Norbert X-Kalay Lift Station Overflow	300	0,000	$ 25,000	Requires Rip Rap
AS 9.9	Sheir Dr.	250		$ 7,000	
AS 26	Ridgedale S.P.S.	250		$ 11,000	"Spot" repair 10 m; Side of CMP pushed in
AS 8	St. Charles Street 1	250		$ 8,000	
	Subtotal		5,000	$ 83,000	
Combined Sewer Overflow					
RR 79	Hart Ave	2850	5,000	$ 103,000	Requires Rip Rap
AS 42	Conway CS	2500	0,000	$ 332,000	Requires Rip Rap
AS 61	Doncastor Street	2250	5,000	$ 170,000	Requires Rip Rap
AS 81	Ruby St. 1	2100	0,000	$ 61,000	Requires Rip Rap
AS 90	Colony Street	1800	5,000	$ 101,000	Requires Rip Rap
RR 52	Marion Street	1800	0,000	$ 70,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 90	Linden Ave.	1800	5,000	$ 35,000	Requires Rip Rap
RR 54	Rue Despins	1400	5,000	$ 46,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 58	Rue Doumoulin	1060	5,000	$ 34,000	Replacement cost only. Pricing is subject to replacement as part of the Future Provencher Bridge project. Requires Rip Rap
RR 96	Larchdale Cres. SPS	1050	0,000	$ 29,000	Requires Rip Rap
AS 37	Strathmillan Road	900	5,000	$ 48,000	Outfall is Submerged. Requires Rip Rap
AS 91	Kennedy Street	760		$ 36,000	
AS 93	Hargrave Street	700		$ 24,000	"Spot" repair 5 m; Pipe has shifted
AS 29	Woodhaven Blvd.	450	5,000	$ 43,000	Requires Rip Rap
RR 37	Calrossie Blvd	450	0,000	$ 24,000	Requires Rip Rap
AS 83	Arlington Street 1	375		$ 12,000	Includes an extra 15m section to extend outfall into the river
	Subtotal		0,000	$ 1,168,000	
Land Drainage Sewer					
FL 2	Kildare at Floodway	3000	5,000	$ 282,000	Requires Rip Rap
ST 3	Booth Drive	1850	5,000	$ 33,000	Requires Rip Rap
AS 16.1	Raquette street 2	1800	5,000	$ 56,000	Requires Rip Rap
AS 19	Carroll Road	1800	0,000	$ 135,000	Requires Rip Rap
RR 7	Cloutier Drive (Segment 1 & 2)	1800/96	0,000	$ 58,000	"Spot" repair 5 m on Segment 1. Requires Rip Rap Repairs
RR 103	Valhalla Drive	1675	0,000	$ 60,000	Requires Rip Rap
FL 1	Deacon Reservoir	1500		$ 29,000	Majority of the joints have started to separate, some > 25mm, Assume $15,000 to grout shifted joints
RR 31	Dunkirk Drive	1400	0,000	$ 43,000	Requires Rip Rap
AS 18	McCallum Cres.	1350		$ 12,000	"Spot" repair 5 m; Outlet is damaged
RR 59	Rue La Verendrye	1200	5,000	$ 60,000	Requires Rip Rap
AS 10	Pender Street	900		$ 12,000	"Spot" repair 5 m; Pipe outlet has some ice damage
RR 28	Dowker Ave. Outfall	900	0,000	$ 23,000	Requires Rip Rap
RR 68	Archibald Underpass	750		$ 23,000	"Spot" repair 5 m; Pipe has shifted; Outfall is Submerged
AS 38	Vialoux Drive Cul-de-Sac	750		$ 28,000	
OM 3	Empress Street 1	750		$ 24,000	
RR 104	Red River Blvd.	750		$ 34,000	
RR 30	Lotus lane	600	0,000	$ 20,000	Requires Rip Rap
SE 2	Rue Laverendrye	600		$ 9,000	"Spot" repair 5 m; Pipe has shifted
RR 41	Churchill Drive Underpass	525	5,000	$ 19,000	Incomplete inspection too much sediment build-up. Requires Rip Rap
RR 108	Eastwood Drive	525	5,000	$ 53,000	Requires Rip Rap
AS 25	Shenfield Road	450	5,000	$ 33,000	Requires Rip Rap
AS 27	Ridgedale Cres	450		$ 12,000	
BU 6	Delbrook Cres.	400		$ 11,000	Pipe collapsed incomplete inspection.
RR 8	Stormont Drive	400	0,000	$ 19,000	Requires Rip Rap
ST 12	Amarynth Cres. 2	400		$ 13,000	
ST 17	Harvest Lane	400	5,000	$ 22,000	Requires Rip Rap
OM 4	Veledrome 1	380	5,000	$ 33,000	Pipe collapsed incomplete inspection. Requires Rip Rap
RR 34	Oakcrest Place	375	0,000	$ 69,000	Requires Rip Rap
AS 70	Empress Street	300		$ 16,000	
	Subtotal		5,000	$ 1,241,000	
	TOTAL		5,000	$ 2,703,000	

Outfall: ST-16 Valleyview Dr. 2 1050 mm

Condition: Top of outlet bent, grating damaged and hanging open

Action: Straighten CMP and reinstall grate

Time: 4 hr.

Cost: $1,000.00

Outfall: AS-10 Pender St. 900 mm

Condition: Outlet bent, opening reduced by 50 %.

Action: Assume damaged portion can be removed or straightened.

Time: 1 day

Cost: $1,000.00

Outfall: AS-13 Willow Ridge Rd. 1800 mm

Condition: Outlet bent inwards and torn. Outlet extends from bank.

Action: trim and remove damaged CMP

Time: 1 day

Cost: $1,000.00

Outfall: AS-18 McCallum Cres. 1350 mm

Condition: CMP closed at outlet, opening reduced by 70%. Outlet extends from bank.

Action: trim and remove damaged CMP

Time: 1 day

Cost: $1,000.00

Outfall: AS-42 Conway CS 2500 mm

Condition: Top of CMP bent

Action: Straighten CMP

Time: 4 hr.

Cost: $1,000.00

Outfall: AS-61 Doncastor St. 2250 mm

Condition: CMP bent at outlet, extends from bank.

Action: trim and remove damaged CMP

Time: 1 day

Cost: $1,000.00

Outfall: AS-67 Wellington Cres. 450 mm

Condition: Top of CMP bent, extends from bank.

Action: trim and remove damaged CMP

Time: 1/2 to 1 day

Cost: $1,000.00

Outfall: AS-78 Elm St. 750 mm

Condition: CMP bent, opening reduced by 25 %.

Action: Assume damaged portion can be removed or straightened.

Time: 1 day

Cost: $1,000.00

Outfall: AS-88 Cornish St. 2 1500 mm

Condition: Grate bent and twisted.

Action: Remove existing grate and install new grate.

Time: 1/2 to 1 day

Cost: Labour $1,000.00 plus New Grate $3,000.00 = $4,000.00

Outfall: RR-100 Whellams Lane 1200 mm

Condition: Top of CMP flattened at end.

Action: Trim and remove damaged portion.

Time: 2 days (some excavation required around pipe).

Cost: Labour $1,000.00 plus Equipment $1,000.00 = $2,000.00

Outfall: RR-59 Rue La Verendrye 1200 mm

Condition: Upstream side of outlet pushed in.

Action: Trim and removed damaged CMP and grate. Install new grate.

Time: 1 to 2 days

Cost: Labour $1,000.00 plus Grate $2,500.00 = $3,500.00

Outfall: RR-60 Rue La Verendrye FPS 600 mm

Condition: CMP bent out of alignment.

Action: Trim and removed damaged CMP.

Time: 1 day

Cost: $1,000.00

Outfall: RR-79 Hart Ave. 2850x2130 mm

Condition: CMP bent and torn at outlet.

Action: Trim and remove damaged CMP.

Time: 1 day

Cost: $1,000.00

Outfall: RR-87 Chelsea Pl 2275mm

Condition: First joint from outlet open and displaced from 9:00 to 3:00. Outlet slightly bent.

Action: Straighten CMP and repair displaced joint.

Time: 1 day

Cost: Labour $1,000.00 plus Mat'l $500.00 = $1,500.00

Outfall: AS-12 Galsworthy Pl. 450 mm

Condition: CMP bent inwards.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: AS-15 Paradise Bay 600 mm

Condition: CMP bent at top and side, outlet extends from bank.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: AS-16.5 Orchard Park 600 mm

Condition: CMP slightly bent, outlet extends from bank.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: AS-19 Carroll Rd. 1800 mm

Condition: CMP bent

Action: Assume CMP can be straightened or trimmed.

Time:

Cost: $1,000.00

Outfall: AS-24 Fairmont 2500 mm

Condition: Small piece of CMP missing at outlet

Action: Replace missing CMP, assume 3 lineal m has to be repaired.

Time: 1 day

Cost: $3,000.00 labour plus $3,000 material = $6,000.00

Outfall: AS-60 Chataway Blvd. 900 mm

Condition: 250 mm wide piece of CMP missing at outlet

Action: Replace missing CMP

Time: 1/2 to 1 day

Cost: $1,000.00 labour plus $500.00 material = $1,500.00

Outfall: AS-63 Riverbend Cres. 2250 mm

Condition: Upstream side of CMP bent.

Action: Trim and remove damaged portion of CMP

Time: 1 day

Cost: $1,000.00

Outfall: AS-67A Route 90 Bridge 450 mm

Condition: Top of CMP bent, opening reduced 10-20%.

Action: assume CMP can be straightened

Time: 1 to 2 hr.

Cost: $1,000.00

Outfall: AS-69 Tylehurst St. 2250 mm

Condition: Protective railing around outlet structure damaged.

Action: Replace 2 sections of railing

Time: 1/2 to 1 day

Cost: $1,000.00 labour plus $1,000.00 material = $2,000.00

Outfall: AS-76 Ash St. FPS 2100 mm

Condition: Upstream side of CMP bent inwards.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: RR-10 Radcliffe 1200 mm

Condition: Minor denting from 9:00 to 12:00

Action:

Time:

note: no hydraulic restriction
re-inspect in 5 years

Cost:

Outfall: RR-15 Rivergate Dr. 1350 mm

Condition: Minor damage 3:00 to 4:00

Action: Assume CMP can be straightened

Time: 1 hr.

Cost: $1,000.00

Outfall: RR-38 Cockburn St. FPS 1500 mm

Condition: CMP slightly bent

Action: Assume CMP can be straightened.

Time: 1 hr.

Cost: $1,000.00

Outfall: RR-51 Marion St. FPD 1600 mm

Condition: Slightly bent btw. 9:00 and 3:00

Action:

note: no hydraulic restriction
re-inspect in 5 years

Time:

Cost:

Outfall: RR-52 Marion St. 2 1800 mm

Condition: 300 mm wide piece of CMP folded over.

Action: Straighten or remove damaged portion

Time:

Cost: $1,000.00

Outfall: RR-54 Rue Despins

Condition: Top of CMP dented

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: RR-55 Rue Despins FPD 1200 mm

Condition: Upstream side of CMP bent.

Action: Straighten or remove bent portion

Time:

Cost: $1,000.00

Outfall: RR-90 Linden Ave. 1800 mm

Condition: Concrete in poor condition.

Action: Remove damaged conc. to good sound concrete. Replace demolished concrete.

Time: 4 to 5 days

Cost: $2,000.00 labour plus $2,000 mat'l = $4,000.00
(assumes $50/hr. labour)

Outfall: RR-2 Lemay Ave. 900 mm

Condition: CMP dented btw. 6:00 and 2:00.

Action: straighten CMP

Time: 1-2 hr.

Cost: $1,000.00

Outfall: RR-35 Wildwood Golf Course 900 mm

Condition: Small dent at top of CMP.

Action:

Time:

note: no hydraulic restriction
re-inspect in 5 years

Cost:

Outfall: RR-41 Churchill Dr. Underpass 800 mm

Condition: Small dents in CMP

Action:

Time:

note: no hydraulic restriction re-inspect in 5 years

Cost:

Outfall: RR-62 McDermont Ave.

Condition: Tapered end of CMP slightly bent upstream side.

Action: straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: LS-2 Rue Des Trappistes 450 mm

Condition: Top of CMP slightly bent.

Action:

Time:

note: no hydraulic restriction re-inspect in 5 years

Cost:

Outfall: FL-2 Kildare at Floodway 3000 mm

Condition: Guard rail around outlet bent.

Action: replace damaged guard rail

Time: 1 day

Cost: $1,000.00 labour plus $2,500 mat'l = $3,500.00

Outfall: SE-37 Fermor Ave. 600 mm

Condition: CMP slightly bent.

Action: Straighten or trim damaged portion.

Time:

Cost: $1,000.00

Outfall: ST-1 Old Mill Rd. 400 mm

Condition: 40 mm dent upstream side of CMP

Action:

note: no hydraulic restriction
re-inspect in 5 years

Time:

Cost:

Outfall: ST-22 Crestview Park Dr. 750 mm

Condition: Small dents in CMP

Action:

note: no hydraulic restriction
re-inspect in 5 years

Time:

Cost:

Outfall: OM-2 Clifton St. Overflow

Condition: Chainlink fence on wingwall damaged.

Action: Repair damaged fence

Time: 1/2 to 1 day

Cost: $1,000.00 labour plus $500.00 mat'l = $1,500.00

Outfall: BU-2 Henderson Hwy. 2 1200 mm

Condition: CMP slightly bent.

Action:

Time:

note: no hydraulic restriction
re-inspect in 5 years

Cost:

Outfall: BU-6.1 Delbrook Cres. 2 600 mm

Condition: Top of CMP bent.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

APPENDIX H
Memorandum

APPENDIX H

MEMORANDUM
Outfall Inspection Program - Economic Analysis of Rehabilitation Alternatives at Unstable Banks

MEMORANDUM

TO: Roy Houston

FROM: Dave MacMillan

DATE: December 5, 1997

RE: Outfall Inspection Program
Economic Analysis of Rehabilitation Alternatives at Unstable Banks

PROJECT NO. 97-107-17

1.0 BACKGROUND

In response to your request, a proposed method to evaluate rehabilitation alternatives for outfall replacements at unstable banks is outlined below for the Steering Committee's review and consideration.

Based upon the assessment to date, an evaluation method is required for those conditions where an outfall needs to be replaced on an unstable bank. Ultimately, the requirement to spend significant expenditures associated with bank stabilization will depend upon the consequences of a bank failure. Where there is no additional consequence, other than the loss of pipe, the decision will tend to favour accepting the risk of bank failure. Where the bank failure consequences are significant, such as a loss of a flood pump station (FPS), impacts on other infrastructure (buried services, roads etc.), then the risk of the additional damages also needs to be considered. In the extreme, a bank failure could lead to an outfall blockage and subsequent upstream flood damages.

Although the total assessment of bank failure consequences can be complex, this methodology is presented to assist the decision making process in those instances where the consequences are limited to the pipe and/or an outfall structure. The methodology, with some effort, could be extended to a more general evaluation of the economics associated with bank stabilization. It is, however, not the intention of this memorandum to explore the level of detail required to consider all of the impacts and consequences of a bank failure. In all cases the assessment should be on a site specific basis and where other bank failure consequences are possible, the results should be interpreted with some caution.

2.0 ASSESSMENT METHODOLOGY

The two scenarios were considered and the evaluation methodology is outlined below.

1. ***Consequence Limited to Loss of the Outfall*** - This evaluation considers the outfall to be replaced on an unstable bank where the consequence of a bank failure is limited to the pipe rupturing. It is assumed that there are no further consequences of the bank failure, such as upstream flooding as a result of a pipe rupture. For this condition, the estimated cost of the bank stabilization is significant in comparison to the loss of the rehabilitation cost of the pipe.

In this example, the decision to proceed with bank stabilization or not depends upon:

- cost of the bank stabilization
- life expectancy of the bank stabilization
- the frequency of which the bank is expected to fail, and
- the cost of the pipe rehabilitation.

The basis for deciding whether or not to stabilize the bank under these conditions is illustrated on Tables 1 and 2 for pipe rehabilitation costs of $30,000 and $150,000.

Based upon these results, it is apparent that for the pipe rehabilitation of less then $150,000 it is more economic to continue to replace the pipe as opposed to stabilize the bank.

2. ***Consequences include Loss of a Flood Pump Station*** - This example considers an outfall to be replaced on a bank where the consequences of a bank failure affects structures, or other infrastructure facilities at the top of the bank. For example, with a flood pump station at the top of the bank, the risk and magnitude of the potential damage to the facility would have to be considered.

   In this case, the decision to proceed with the bank stabilization depends upon:

   - cost of the bank stabilization
   - life expectancy of the bank stabilization
   - the frequency of which the bank is expected to fail
   - the cost of the pipe rehabilitation, and
   - consequences, in terms of damage to the FPS and potential district flooding if the FPS is out of service during a significant spring event where the pumps are required.

   As illustrated in Table 3, 4 and 5, it would be economically advantageous to stabilize the bank if there is a realistic probability of bank failure (ie. greater than 1/300, p= 0.003).

   For an unstable the probability of failure is likely in the order of 1/5, p = 0.2 to 1/20, p = 0.05.

3.0 DATA REQUIRED

To implement the methodology, an assessment of the probability and damages associated with a bank failure would be required on a case by case basis. As well, cost estimates for pipe rehabilitation and bank stabilization would be necessary.

Variables that may be considered would include:

- cost of works (both repair & stabilization)
- actual risk of failures dependent on soil/geometry/precipitation/flood condition
- structure type/location/foundation type
- movement may damage but not block pipe
- small Ø pipes will be more susceptible to blockage
- assessment may have to include costs associated with potential surface flooding which could damage roads, flood basements or surcharge bank failures
- value of land, potentially lost due to bank failure

Table 1

Present Value Cost Comparison Example (1)
Pipe Replacement at Frequency of Bank Failure vs Bank Stabilization

Assumptions		Economic Paramters	
Pipe rehabilitation cost	$\boxed{\$30,000}$	interest rate	8 percent
Bank stabilization cost	$300,000	escalation rate	3 percent
Frequency of bank failure (yrs)	10	net discount rate	5 percent
Life Span of Bank Stabilization (yrs)	50		

Present Value Cost Comparison

Present Value of Bank Stabilization	$300,000	(cost of bank stabilization)
Present Value of Pipe Repairs	$70,041	(cost of pipe repair at frequency of bank failure)

On the basis of a cost comparison

Bank Stabilization is not Justified

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

Table 2

Present Value Cost Comparison Example (1)
Pipe Replacement at Frequency of Bank Failure vs Bank Stabilization

Assumptions		Economic Paramters	
Pipe rehabilitation cost	$\boxed{\$150{,}000}$	interest rate	8 percent
Bank stabilization cost	$300,000	escalation rate	3 percent
Frequency of bank failure (yrs)	10	net discount rate	5 percent
Life Span of Bank Stabilization (yrs)	50		

Present Value Cost Comparison

Present Value of Bank Stabilization	$300,000	(cost of bank stabilization)
Present Value of Pipe Repairs	$350,204	(cost of pipe repair at frequency of bank failure)

On the basis of a cost comparison

Bank Stabilization is Justified

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

Table 3

Present Value Cost Comparison Example (1)
Risk Assessment of Bank Stabilization Requiremnt

Assumptions

A	Risk of Bank Failure (Probability of failure)	0.1
B	Risk of Flooding Following Loss of FPS (prob of rainstorm)	0.1
C	Probabiltiy of Combined Event (A * B)	0.01
	Consequcne of failure (potential damages)	
D	-loss of Flood Pump Station	$3,000,000
E	- flood damges due to event C	$5,000,000
	Annual Risk of Damages	
F	- loss of FPS (A * D)	$300,000
G	- flood damages (C * E)	$50,000
H	- total annual damages (F + G)	$350,000

Economic Parameters

interest rate	8	percent
escalation rate	3	percent
net discount rate	5	percent
economic life	50	yrs

I	Cost of Bank Staiblization	$300,000
J	Annual Cost of Bank Stabilzation (50yr life @ cost I)	$16,433
K	Annual Benfits of Bank Stablization (avoided damages - H)	$350,000

Benefit Cost Ratio (Annual Damages Avoided / Annual Costs)

K / J **21.3**

Bank Stabilzation is Justified

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

Table 4

Present Value Cost Comparison Example (1)
Risk Assessment of Bank Stabilization Requiremnt

Assumptions

A	Risk of Bank Failure (Probability of failure)	0.01
B	Risk of Flooding Following Loss of FPS (prob of rainstorm)	0.1
C	Probabiltiy of Combined Event (A * B)	0.001
	Consequcne of failure (potential damages)	
D	-loss of Flood Pump Station	$3,000,000
E	- flood damges due to event C	$5,000,000
	Annual Risk of Damages	
F	- loss of FPS (A * D)	$30,000
G	- flood damages (C * E)	$5,000
H	- total annual damages (F + G)	$35,000

Economic Parameters

interest rate	8	percent
escalation rate	3	percent
net discount rate	5	percent
economic life	50	yrs

I	Cost of Bank Staiblization	$300,000
J	Annual Cost of Bank Stabilzation (50yr life @ cost I)	$16,433
K	Annual Benfits of Bank Stablization (avoided damages - H)	$35,000

Benefit Cost Ratio (Annual Damages Avoided / Annual Costs)

K / J **2.1**

Bank Stabilzation is Justified

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

Table 5

Present Value Cost Comparison Example (1)
Risk Assessment of Bank Stabilization Requiremnt

Assumptions

A	Risk of Bank Failure (Probability of failure)	$\boxed{0.003}$
B	Risk of Flooding Following Loss of FPS (prob of rainstorm)	0.1
C	Probabiltiy of Combined Event (A * B)	0.0003
	Consequcne of failure (potential damages)	
D	-loss of Flood Pump Station	$3,000,000
E	- flood damges due to event C	$5,000,000
	Annual Risk of Damages	
F	- loss of FPS (A * D)	$9,000
G	- flood damages (C * E)	$1,500
H	- total annual damages (F + G)	$10,500

Economic Parameters

interest rate	8	percent
escalation rate	3	percent
net discount rate	5	percent
economic life	50	yrs

I	Cost of Bank Staiblization	$300,000
J	Annual Cost of Bank Stabilzation (50yr life @ cost I)	$16,433
K	Annual Benfits of Bank Stablization (avoided damages - H)	$10,500

Benefit Cost Ratio (Annual Damages Avoided / Annual Costs)

K / J **0.6**

Bank Stabilzation is not Justified

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

APPENDIX I
Suggested Outfall Inspections

APPENDIX I

SUGGESTED OUTFALL INSPECTIONS FOR YEAR 1 AND 2

Suggested Outfall Inspections Year 1 (1999)

Outfall ID	Outfall Name	Reason for Inspection
ST-9	Amarynth Cres.	Overall Rating of 4 (96-97)
AS-77	Ash St.	Outfall not inspected (96-97)
AS-32.1	Assiniboine Cres.	Outfall not inspected <= 300 mm dia.
AS-79	Aubrey St.	Outfall not inspected (96-97)
RR-45	Baltimore St. FPS	Overall Rating of 4 (96-97)
RR-21.1	Bishop Grandin Bvld 4	Overall Rating of 4 (96-97)
RR-21.1	Bishop Grandin Bvld 4	Outfall not inspected (96-97)
BU-7	Bonner Ave. 1	Overall Rating of 4 (96-97)
BU-7	Bonner Ave. 1	Outfall not inspected (96-97)
BU-8	Bonner Ave. 2	Outfall not inspected (96-97)
AS-85	Canora St.	Outfall not inspected (96-97)
AS-21	Carroll Rd. 2	Outfall not inspected <= 300 mm dia.
AS-32.4	Charleswood Bridge Drain - North 1	Outfall not inspected <= 300 mm dia.
AS-32.2	Charleswood Bridge Drain - South	Outfall not inspected <= 300 mm dia.
AS-32.3	Charleswood Bridge Drain - South 2	Outfall not inspected <= 300 mm dia.
AS-32.5	Charleswood Bridge Drain - South 3	Outfall not inspected <= 300 mm dia.
AS-60	Chataway Blvd.	Overall Rating of 4 (96-97)
SE-41	Clayton Dr.	Overall Rating of 4 (96-97)
AS-75	Clifton St.	Overall Rating of 4 (96-97)
OM-2	Clifton St. Overflow	Outfall not inspected (96-97)
AS-86	Cornish Ave FPS	Overall Rating of 4 (96-97)
AS-88	Cornish St. 2	Overall Rating of 4 (96-97)
RR-26	Crane Ave.	Overall Rating of 4 (96-97)
RR-27	Crane Ave. Outfall	Overall Rating of 4 (96-97)
ST-21	Crestview Park Dr. (retention pond drainage)	Overall Rating of 4 (96-97)
RR-20	Darcy Dr.	Overall Rating of 4 (96-97)
AS-53	Deer Lodge Pl.	Outfall not inspected <= 300 mm dia.
BU-6.1	Delbrook Cres. 2	Overall Rating of 4 (96-97)
BU-6.1	Delbrook Cres. 2	Outfall not inspected (96-97)
RR-47	Eccles St.	Outfall not inspected (96-97)
AS-78	Elm St.	Overall Rating of 4 (96-97)
RR-81	Elmwood Park	Overall Rating of 4 (96-97)
OM-15	Empress St. 10	Outfall not inspected <= 300 mm dia.
OM-16	Empress St. 11	Outfall not inspected <= 300 mm dia.
OM-17	Empress St. 12	Outfall not inspected <= 300 mm dia.
OM-18	Empress St. 13	Outfall not inspected <= 300 mm dia.
OM-19	Empress St. 14	Outfall not inspected <= 300 mm dia.
OM-21	Empress St. 16	Outfall not inspected <= 300 mm dia.
OM-22	Empress St. 17	Outfall not inspected <= 300 mm dia.
OM-23	Empress St. 18	Outfall not inspected <= 300 mm dia.
OM-24	Empress St. 19	Outfall not inspected <= 300 mm dia.
OM-12	Empress St. 7	Outfall not inspected <= 300 mm dia.
OM-13	Empress St. 8	Outfall not inspected <= 300 mm dia.
OM-14	Empress St. 9	Outfall not inspected <= 300 mm dia.
AS-24	Fairmont	Outfall not inspected (96-97)
SE-37	Fermor Ave.	Overall Rating of 4 (96-97)
AS-59	Ferry Rd.	Outfall not inspected (96-97)
AS-92	Fort Rouge Park	Overall Rating of 4 (96-97)
AS-92	Fort Rouge Park	Outfall not inspected (96-97)

Suggested Outfall Inspections Year 1 (1999)

Outfall ID	Outfall Name	Reason for Inspection
SE-29	Gareau St.	Overall Rating of 4 (96-97)
BU-16	Gateway Rd.	Outfall not inspected (96-97)
RR-6	Grandmont Blvd.	Overall Rating of 4 (96-97)
ST-18	Hamilton Ave.	Overall Rating of 4 (96-97)
ST-18.1	Hamilton Ave. 2	Overall Rating of 4 (96-97)
RR-98	Hawthorne Ave.	Overall Rating of 4 (96-97)
BU-18	Jim Smith Dr.	Outfall not inspected (96-97)
RR-12	Kings Dr.	Overall Rating of 4 (96-97)
RR-40	Kingston Row Underpass	Overall Rating of 4 (96-97)
RR-61	Lombard Ave.	Outfall not inspected (96-97)
BU-23	Mallows Way	Outfall not inspected (96-97)
AS-86B	Maryland St.	Outfall not inspected (96-97)
AS-99	Mayfair Ave.	Overall Rating of 4 (96-97)
AS-99	Mayfair Ave.	Outfall not inspected (96-97)
BU-12	McIvor Ave.	Overall Rating of 4 (96-97)
AS-32	McQuaker Dr.	Outfall not inspected (96-97)
RR-46	Metcalfe Pl.	Overall Rating of 4 (96-97)
SE-1	Mission FPS	Overall Rating of 4 (96-97)
AS-39	Mount Royal Cres. 1	Outfall not inspected <= 300 mm dia.
AS-31	Oakdale Dr.	Outfall not inspected (96-97)
AS-33	Olive St.	Overall Rating of 4 (96-97)
AS-34	Olive St. 2	Outfall not inspected (96-97)
AS-62	Parkside Dr.	Overall Rating of 4 (96-97)
RR-11	Radcliffe	Overall Rating of 4 (96-97)
RR-11	Radcliffe	Outfall not inspected (96-97)
RR-10	Radcliffe 1	Overall Rating of 4 (96-97)
OM-1	Raglan Rd.	Overall Rating of 4 (96-97)
BU-17	Regatta Rd.	Outfall not inspected <= 300 mm dia.
BU-19	Regatta Rd. 2	Outfall not inspected <= 300 mm dia.
AS-72	Renfrew St.	Outfall not inspected (96-97)
RR-18	River Pointe Pl.	Overall Rating of 4 (96-97)
AS-63	Riverbend Cres.	Overall Rating of 4 (96-97)
RR-23	Riviera Cres. Outfall	Overall Rating of 4 (96-97)
BU-4	Rothesay St. N.	Outfall not inspected (96-97)
BU-5	Rothesay St. S.	Outfall not inspected (96-97)
AS-67A	Route 90 Bridge	Overall Rating of 4 (96-97)
AS-65A	Route 90 Overpass	Outfall not inspected <= 300 mm dia.
SE-53.1	Royalwood Subdivision	Overall Rating of 4 (96-97)
AS-82	Ruby St. 2	Outfall not inspected (96-97)
SE-34	Rue Archibald St.	Overall Rating of 4 (96-97)
SE-10	Rue Bourgeault	Overall Rating of 4 (96-97)
LS-1.1	Rue Campeau	Outfall not inspected <= 300 mm dia.
SE-4	Rue Notre Dame W.	Overall Rating of 4 (96-97)
ST-24	Saskatchewan Ave.	Overall Rating of 4 (96-97)
RR-14	SEWPCC Outfall	Outfall not inspected (96-97)
AS-20	Shelmardine Dr.	Outfall not inspected <= 300 mm dia.
ST-19	Silver Ave.	Overall Rating of 4 (96-97)
AS-89	Spence St.	Overall Rating of 4 (96-97)
AS-89	Spence St.	Outfall not inspected (96-97)

Suggested Outfall Inspections Year 1 (1999)

Outfall ID	Outfall Name	Reason for Inspection
RR-16	St. Mary's Rd. 2	Overall Rating of 4 (96-97)
RR-106	Summerview Lane	Outfall not inspected (96-97)
BU-20	Sun Valley Dr.	Outfall not inspected (96-97)
BU-21	Sunny Hills Rd.	Outfall not inspected (96-97)
AS-97	The Forks E. of C.N.R. Bridge	Outfall not inspected (96-97)
BU-10	Uxbridge Rd. N.	Overall Rating of 4 (96-97)
BU-11	Uxbridge Rd. S.	Overall Rating of 4 (96-97)
ST-15	Valleyview Dr. 1	Overall Rating of 4 (96-97)
ST-16	Valleyview Dr. 2	Overall Rating of 4 (96-97)
OM-11	Velodrome 2	Outfall not inspected <= 300 mm dia.
OM-10	Velodrome Meter Pit	Outfall not inspected <= 300 mm dia.
RR-29	Victoria Cres. 2	Overall Rating of 4 (96-97)
RR-29	Victoria Cres. 2	Outfall not inspected (96-97)
ST-20	Voyageur	Overall Rating of 4 (96-97)
RR-56	Water Ave.	Outfall not inspected (96-97)
RR-56.1	Water Ave. 2	Outfall not inspected (96-97)
AS-67	Wellington Cres. at CNR Bridge	Outfall not inspected (96-97)
AS-1	WEWPCC Outfall	Outfall not inspected (96-97)
AS-36A	Wexford Lift Station	Outfall not inspected <= 300 mm dia.
BU-22	Wpg. Hydro Transmission Line	Outfall not inspected (96-97)

Suggested Outfall Inspections Year 2 (2000)

Outfall ID	Outfall Name	Reason for Inspection
RR-76.5	Aberdeen Ave.	Outfall not inspected <= 300 mm dia.
ST-13	Alcott	Outfall not inspected (96-97)
SE-35	Avondale Rd.	Outfall not inspected (96-97)
SE-49	Beliveau Rd.	Outfall not inspected (96-97)
SE-42	Berrydale Ave.	Outfall not inspected (96-97)
SE-52	Bishop Grandin Bvld.	Outfall not inspected (96-97)
SE-14	Cherrier St.	Outfall not inspected <= 300 mm dia.
RR-47.5	Churchill High School	Outfall not inspected (96-97)
SE-41	Clayton Dr.	Outfall not inspected (96-97)
SE-57	Compark	Outfall not inspected (96-97)
SE-24.1	Deniset St. 1	Outfall not inspected <= 300 mm dia.
SE-26	Deniset St. 2	Outfall not inspected <= 300 mm dia.
SE-15	Doucet St.	Outfall not inspected <= 300 mm dia.
SE-25	Dubuc St.	Outfall not inspected <= 300 mm dia.
SE-19	Dugald Ditch S. 1	Outfall not inspected <= 300 mm dia.
SE-20	Dugald Ditch S. 2	Outfall not inspected <= 300 mm dia.
RR-47.1	Eccles St. 2	Outfall not inspected (96-97)
RR-81	Elmwood Park	Outfall not inspected (96-97)
OM-5	Empress St. 2	Outfall not inspected <= 300 mm dia.
OM-25	Empress St. 20	Outfall not inspected <= 300 mm dia.
OM-26	Empress St. 21	Outfall not inspected <= 300 mm dia.
OM-6	Empress St. 3	Outfall not inspected <= 300 mm dia.
OM-7	Empress St. 4	Outfall not inspected <= 300 mm dia.
OM-8	Empress St. 5	Outfall not inspected <= 300 mm dia.
OM-9	Empress St. 6	Outfall not inspected <= 300 mm dia.
RR-32.5	Fermor Ave	Outfall not inspected (96-97)
SE-40	Fernwood Ave.	Outfall not inspected (96-97)
RR-64	Galt Ave. FPS	Outfall not inspected (96-97)
SE-13	Giroux St.	Outfall not inspected <= 300 mm dia.
ST-7.1	Greenway Cres. 2	Outfall not inspected (96-97)
ST-18.1	Hamilton Ave. 2	Outfall not inspected (96-97)
SE-45	Hindley Ave.	Outfall not inspected (96-97)
RR-85	Inkster Blvd.	Outfall not inspected (96-97)
RR-34.1	Kingston Row	Outfall not inspected <= 300 mm dia.
SE-51	Lavalee Rd.	Outfall not inspected (96-97)
ST-10	Lonsdale Dr. 2	Outfall not inspected <= 300 mm dia.
SE-16	Marion St.	Outfall not inspected <= 300 mm dia.
RR-62	McDermot Ave.	Outfall not inspected (96-97)
SE-50	N. of Beaverhill Bvld.	Outfall not inspected (96-97)
SE-55	N. of John Bruce Rd.	Outfall not inspected (96-97)
ST-14	Ness Ave.	Outfall not inspected (96-97)
RR-99	NEWPCC Outfall Kildonan Golf Course	Outfall not inspected (96-97)
ST-2	Oakdean Cres.	Outfall not inspected <= 300 mm dia.
ST-1	Old Mill Rd.	Outfall not inspected (96-97)
RR-47.4	Open Culvert from Football Field	Outfall not inspected <= 300 mm dia.
SE-6	Provencher Bvld.	Outfall not inspected <= 300 mm dia.
SE-7	Provencher Bvld. 2	Outfall not inspected <= 300 mm dia.
SE-9	Provencher Bvld. 3	Outfall not inspected <= 300 mm dia.
SE-54	Public Lane E. of Meadowood Dr.	Outfall not inspected (96-97)

Suggested Outfall Inspections Year 2 (2000)

Outfall ID	Outfall Name	Reason for Inspection
SE-53	Richfield Ave.	Outfall not inspected (96-97)
RR-93	Rossmere Cres.	Outfall not inspected (96-97)
SE-53.1	Royalwood Subdivision	Outfall not inspected (96-97)
SE-10	Rue Bourgeault	Outfall not inspected (96-97)
SE-3	Rue Notre Dame E.	Outfall not inspected <= 300 mm dia.
SE-11	Rue Plinguet	Outfall not inspected <= 300 mm dia.
SE-44	Sadler Ave.	Outfall not inspected (96-97)
SE-58	Southglen	Outfall not inspected (96-97)
SE-58.1	St. Annes Rd.	Outfall not inspected (96-97)
SE-22	St. Catherine St. 2	Outfall not inspected <= 300 mm dia.
RR-16	St. Mary's Rd. 2	Outfall not inspected (96-97)
RR-39.7	St. Vital Bridge	Outfall not inspected (96-97)
ST-4	Sturgeon Rd. (north)	Outfall not inspected (96-97)
ST-5	Sturgeon Rd. (south)	Outfall not inspected (96-97)
SE-23	Tremblay St.	Outfall not inspected <= 300 mm dia.
SE-48	Willowlake Cres.	Outfall not inspected (96-97)
SE-56	Woodydell	Outfall not inspected (96-97)
SE-46	Worthington Ave.	Outfall not inspected (96-97)

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(Winnipeg outfall condition and maintenance. 1998)
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1. KGS Group
2. Kontzamanis Graumann Smith MacMillan Inc.
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THE CITY OF WINNIPEG • VILLE DE WINNIPEG
WATER AND WASTE DEPARTMENT • SERVICE DES EAUX ET DÉCHETS

T.P.

CITY OF WINNIPEG

OUTFALL CONDITION AND MAINTENANCE STUDY

FINAL REPORT

August, 1998

PROPERTY
OF THE
WATER & WASTE DEPARTMENT
RESOURCE CENTRE
1500 PLESSIS ROAD

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KGS GROUP

KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

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CONSULTING ENGINEERS & PROJECT MANAGERS

August 27, 1998 96-107-12

City of Winnipeg
Water and Waste Department
1500 Plessis Road
Winnipeg, Manitoba
R2L 5G6

ATTENTION: Ron Amann C.E.T.
Project Manager

RE: Outfall Condition and Maintenance Study
Final Report and Database Manual

Dear Mr. Amann:

Please find enclosed 11 copies of the final report for the Outfall Condition and Maintenance Study, and 10 copies of the Database Manual. The report and manual include the findings and results of the study performed over the last two years. We have addressed the comments and concerns which were identified from the draft report, and have incorporated them into the final version.

At this time, KGS Group would like to extend its appreciation and thanks to the Steering Committee members and the many WWD personnel whose assistance during the course of the study was extremely valuable. Particular thanks is extended to the branches of the WWD including: Project Management; Design and Contracts; Drafting and Graphic Services; Information Systems; Local Services (East, North and South Areas); and Regional Operations. With the assistance of the WWD, we believe that the results of the study will provide the City with a superior planning tool for future budgeting of capital and required operation and maintenance tasks.

Following the submission of this final report, KGS Group will provide the WWD with the transfer of the information management system, the photo library and the list of discrepancies found between observed data and that contained in LBIS.

We are looking forward to providing the Department with continued engineering services for the implementation of the proposed improvements. If you have any further questions or concerns, please do not hesitate to call.

Yours very truly,

Roy Houston

Roy J. Houston, P.Eng.
Municipal Project Manager

PROVINCE OF MANITOBA
R. J. HOUSTON
Aug 28/98
REGISTERED ENGINEER

RJH/md

enclosure:

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

In 1996, KGS Group was commissioned to perform a comprehensive study to assess the existing condition and the required maintenance for all the outfalls within the City of Winnipeg under the responsibility of the Water and Waste Department (WWD). The enclosed report documents the findings of the study which included a detailed inventory review; inspection program; database development; condition assessment; estimated costs for capital upgrades and required maintenance over a five year planning period.

The inventory review revealed approximately 387 outfalls within the city limits, of which, 350 fall under the responsibility of the WWD and 37 were listed as privately owned. These outfalls were determined to be under the jurisdiction of other municipal or provincial departments, the University of Manitoba or private industry and residences. All attempts were made to locate outfalls identified in previous studies, however, 12 outfalls were not included in the inventory as they were either abandoned or not found, even with the aid of WWD personnel. A complete set of inventory drawings was produced and is included with this report. Digital and full size mylar copies were also forwarded to the WWD.

A comparison was made between the information gathered during the inventory review and existing information contained in the City's Land Based Information System (LBIS). Some discrepancies were noted and reported to the WWD. A detailed list of discrepancies was forwarded as a separate document to the City to enable the WWD to update LBIS and make it consistent with what was found during the inventory review.

To provide a means of assessing the outfalls a detailed inspection program was devised which focused upon the structural aspects of the pipe, the geotechnical bank conditions, and the stream's hydraulic conditions at the pipe. All three aspects were deemed equally important, and if even one of the conditions was found to be in a failed state, it was determined that the outfall was in a failed state and needed to be repaired. From this a condition rating system was devised. Originally KGS Group developed a six point rating system, the ratings were subsequently revised to reflect a 5 point system. A failed outfall was assigned a rating of 5, and a completely satisfactory outfall was assigned a rating of 1. Three ratings were given to each outfall inspected based upon the structural, geotechnical and stream conditions noted at the time of the inspection. KGS Group provided a standard inspection form and rating guidelines to the WWD for use in future inspections and assessments.

Due to high river levels and above normal snow accumulations, KGS Group was forced to complete the inspection over two "low water" seasons. During Phase 1 (1996-97) 121 outfalls were inspected. Additionally, 9 outfalls less than 300 millimetres in diameter and 7 private outfalls were inspected during Phase 1, after which, KGS Group was instructed not to inspect outfalls in these two categories. During the low season of the fall of 1997, 77 outfalls were internally inspected for structural assessment. Inspections were hampered again by high water levels and 77 outfalls were unable to be accessed for inspection. The majority of the access problems were due to submerged conditions at the outfall. A total of 256 outfalls located from the banks were assessed for the geotechnical and hydraulic site conditions, and rated accordingly. In summary, approximately 71 percent of the outfalls that KGS Group was directed to assess were inspected internally for structural conditions.

As part of the Outfall Condition and Maintenance Study, KGS Group developed a computerized information management system (IMS), or database, for all known sewer outfalls within the City of Winnipeg. The database provides a comprehensive record of inventory and inspection information gathered by KGS Group for the outfalls. The database is to be used as an operational tool, and as a means of storing and retrieving the outfall condition information collected. As well, the IMS can be used to facilitate historical tracking of data for inspection and maintenance planning for each outfall. The IMS is programmed with three main modules for entering data; updating the data with new or revised information; and a search module for easy database query. Submitted as a separate document to this report is a database manual explaining the use and structure of the IMS.

All inspection details and condition ratings were entered into the database. It was found that the distribution of ratings among the 5 categories was fairly even. Of the failed outfalls, the majority were determined to be caused by a structural failure of the pipe, and nine outfalls had a failed condition in two or three of the categories (structural, geotechnical and stream). It was determined that approximately 66 percent of the structural failures were found in outfalls that were part of the land drainage system. The smaller number of geotechnical and stream failures was attributed to the outfall reconstruction program, which provided for upgraded bank and erosion protection works in areas adjacent to rehabilitated outfalls.

An assessment of the required rehabilitation works was performed. Approximately 50 outfalls require capital upgrades due to structural failures. Most were in a failed state requiring total replacement of the outfall. A priority ranking system was developed based upon the consequences of total failure of the outfall. Higher risks were assigned to flood pump discharge outfalls than land drainage system outfalls. Larger outfalls were associated with larger services areas, therefore were also given a higher priority. The total estimated cost of the associated repairs was $2,138,000.00. This figure includes the replacement cost for 41 outfall pipes plus the costs of repairing small sections ("spot" or internal repairs) on 9 other outfalls. The figure also includes cost for replacing failed outfalls which are currently under study for sewer relief or other major infrastructure projects. In addition, an estimate was made for any associated erosion protection measures necessary to ensure a reasonable life span of rehabilitated outfalls. A total of $565,000.00 was estimated for those outfalls which require riprap protection at the outlet. The total estimated cost for the required capital upgrades is $2,703,000.00.

A methodology for an economic analysis to compare rehabilitation alternatives of outfalls on unstable banks was developed by KGS Group, and reviewed by WWD, during the study. The methodology compares two scenarios in which the justification for bank stabilization works, as opposed to rehabilitating the outfall pipes after a recurrence of a bank failure, is assessed. The first scenario considered that the consequence of bank failure is limited to the loss of the outfall, and there is no other significant economic impact such as flooding upstream due the pipe failure. The

Additional losses beyond the direct damage to the outfall could include the loss of a flood pump station, and subsequent basement flooding upstream, and/or other important infrastructure works such as a street. Two outfalls were identified during the study to have failed because of their location on an unstable bank. The economic analysis determined that the bank stabilization measures were not justified when considering the economics directly related to the outfall pipes. At another outfall location, the City agreed to stabilize the river bank adjacent to the outfall by cost sharing the project with adjacent land owners. It was recommended that this scenario be pursued at other locations to justify costly bank stabilization works. Each case is unique, and the cost sharing agreement would have to be negotiated independently based upon such factors as adjacent land use, and the requirements for the stabilization.

The study also determined the requirements for continued outfall operation and maintenance (O&M). Recommendations and cost estimates were formulated to address the requirements for erosion protection maintenance (riprap repairs); ice damage repairs; cleansing of pipes subject to sediment buildup; and on going inspections. Estimates were based upon recent experience and discussion with local contractors. Estimated costs for erosion protection maintenance amounted to $97,500.00. Ice damage repairs were separated into to categories and major repairs amounted to $10,500.00 while minor repairs were estimated to be $19,000.00. Sediment buildup maintenance was also categorized as being either major or minor. The estimated costs were $127,000.00 and $87,000.00 respectively. Future inspection costs were also determined based upon the costs incurred during the study, and were estimated to be $181,000.00. A contingency of approximately $25,000.00 should be carried to account for extra costs associated with dewatering outfall pipes (<1200 mm diameter) that a normally submerged. Larger pipes which are normally submerged would have to be assessed individually before determining a methodology and cost for inspection. The total estimated O&M costs for the above items is $552,000.00.

Based upon the total estimated costs for capital upgrades and recommended O&M, a five year plan was devised to phase the work and distribute the expenditures. The WWD has allocated $552,000.00 per year for capital upgrades which is adequate based upon the results of the study and estimated costs. As well, it was recommended that a $100,000.00 per year O&M budget be maintained to address O&M requirements identified in the study. This budget is currently under review by the WWD.

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SECTION 1.0
Introduction

1.0 INTRODUCTION

The operation and maintenance of the sewer outfalls along the Red and Assiniboine River and the tributary streams within the City of Winnipeg are the responsibility of the Water and Waste Department (WWD). Since assuming jurisdiction over these outfalls in 1995, separate outfall inventories have been conducted on the Red and Assiniboine River and on the tributary streams. This database is essentially complete. The Water and Waste Department, however, does not have an inventory which adequately defines the condition and maintenance requirements at the outfalls.

KGS Group was retained to perform the "Outfall Condition and Maintenance Study" in 1996. The study was commissioned to provide the WWD with a comprehensive and thorough review of the condition of all sewer outfalls within the department's jurisdiction. The scope of the study consisted of identifying the outfalls, determining the condition of each by physical and closed circuit television inspection, documentation of the resulting information within an operational database, and providing recommendations for necessary rehabilitation and/or maintenance.

Of those outfalls scheduled to be inspected, approximately 70 percent were completed. The remainder of outfalls were not inspected primarily due to submergence of the outlet for reasons of design or high water/ice levels. Regardless of the inspection status, all outfalls that were identified during the inventory review are included in the database.

The following report summarizes the findings, conclusions and recommendations of the study. A comprehensive review of the outfall inventory was completed and is discussed in Section 2.0. The link between the outfall inventory and the City's Land Based Information System (LBIS) is provided in Section 3.0. The inspection methodology and results of the inspections are given in Section 4.0. A description of the Information Management System (IMS) is given in Section 5.0 while Section 6.0 provides commentary on the assessed condition of those outfalls inspected. Section 7.0 gives details in regards to recommended repairs and the associated estimated costs for the necessary capital upgrades. Similarly, Section 8.0 describes the operation and maintenance work required for the outfalls. Estimated costs are provided. Section 9.0 contains details about phasing the repairs and maintenance over a five year period. Finally, Section 10.0 lists the general conclusions and recommendations resulting from the study.

SECTION 2.0
Inventory Review

2.0 INVENTORY REVIEW

An important objective of the outfall condition and maintenance study was to determine and document an accurate inventory of all existing outfalls. The inventory was necessary to confirm, update and/or revise the existing collection of outfall information. The confirmation of the outfall inventory included all the outfalls known to be under the responsibility of the Water and Waste Department (WWD), and those under the responsibility of others. Those outfalls not under the direct responsibility of the WWD were designated private outfalls. Private outfalls included outfalls under the responsibility of the Parks & Recreation Department, the University of Manitoba, the Manitoba Department of Highways as well as industrial, commercial and private sectors.

The inventory assessment was initiated by a comprehensive review of all relevant data sources provided by the city including:

- River and Tributary Stream Outfall Inventory Drawings (prepared by Alex Kelly for the City of Winnipeg, 1991);
- Land Based Information System (LBIS) data;
- WWD personnel;
- "As-built" Drawings and Atlas Sheets;
- Rivers and Streams - Record Summary Report

A base inventory list was prepared from the information found on the River and Tributary Stream Outfall Inventory Drawings which included information on each outfall such as, size, type and material. This inventory was then checked against the information contained in the LBIS database. The City of Winnipeg forwarded electronic file copies of extracted outfall data from the LBIS. Working drawings were produced from these files, and compared to the information in the existing inventory. The base inventory was then modified or confirmed by available "as-built" drawings and/or by field investigations aided by WWD personnel. Table 2.1 lists the outfalls for which "as-built" drawings were used to confirm the inventory information. Following the review, discrepancies between this data and the LBIS data were reported back to the client to enable it to update the LBIS system as discussed in Section 3.0. Additional relevant information that was found through a search of the Rivers and Streams Record Summary Report was also incorporated into the inventory as necessary.

Based upon the review of the existing data and field investigation, the outfall inventory was revised and updated by KGS Group. In addition, the River and Tributary Stream Outfall Inventory Drawings were revised and updated based on the results of the inventory review. In conjunction with the revised drawings, a naming convention was adapted which was agreed upon by the Steering Committee and others involved in outfall maintenance activities. The revised names of all outfalls was necessary to provide a unique name for each outfall, which could be used by all levels and sections within the WWD. All attempts were made to make the revised names of flood pumping station outfalls consistent with those in the flood pumping manual. The revised names for all outfalls appear on the River and Tributary Stream Outfall Inventory Drawings, and are used consistently with the associated outfall identification numbers (Outfall ID No.) throughout the study and database. A complete set of the drawings is included in Appendix A. The text font used on the drawings was made larger to allow for easier reading of 11" x 17" Drawings.

A total of 387 outfalls were identified during the inventory documentation process. Table 2.2, provides a listing of the number outfalls categorized by owner, size and stream. Of the total number of outfalls identified, KGS Group was directed to inspect only those outfalls owned by the city which were larger than 300 mm in diameter. The inspections also excluded the ditches and channels. Based upon this assessment criteria the total number outfalls to be inspected was 259 as outlined in Table 2.2. The discussion of the inspection methodology is presented in Section 4.0.

Ditches and channels were included in the inventory as was the case in previous studies. Ditches were considered to be significant drainage ditches that discharged into one of the named streams (ie., Red River, Assiniboine River, Bunn's Creek, etc.). The ditches usually entered the stream via, a drop structure or riprap controlled outlet for erosion protection. Channels were considered to be the major tributary to the named streams. For example, where Omand's Creek enters the Assiniboine River the outfall of Omand's Creek (AS-73) is identified as a channel.

As can be seen in Table 2.2, four of the outfalls, namely: RR72 - Syndicate, RR70.1, RR70.2 and RR70.3 - Watt Street are identified as connector pipes. These pipes are part of the outfall structure, but do not discharge directly into a receiving water body. They are intermediate pipes between the discharge pipe at the outlet (ie., RR71 and RR70), and the first structure (manhole, gate chamber, etc.,). The terms of reference for the inspections defined that an outfall was considered to be the pipe or pipes from the outlet at the river to the first structure upstream. Therefore, these connector pipes were included in the inventory and inspections.

Twelve [12] outfalls which were previously identified on the inventory maps were either abandoned or not found in the field, and are not included in the inventory or database. These 12 outfalls are listed in Table 2.3 below. The outfalls were not included in the database, but the abandoned outfalls are shown on the inventory drawings included in Appendix A. The outfalls were eliminated when they could not be located in the field by KGS Group, with the aid of local sewer and water personnel.

TABLES

Table 2.1 Outfall "As-built" Drawings Used

Outfall ID No.	Name	Year	Drawing Number
RR-44	Mager Dr. FPS	1993	LD-1248
RR-46	Metcalfe Pl.	1992	LD-1144
RR-76	Burrows Ave.	1997	LD-1635
RR-80	St. John's Park	1997 1997	LD-1636 LD-1637
RR-104	Red River Blvd.	1997	LD-1638
RR-106	Summerview Lane	1997	LD-1639
AS-16.1	Raquette St,	1988	WC-1968
AS-23	Dieppe Rd.	1969	372
AS-88	Cornish Avenue	1986	LD-569
AS-99	Mayfair Ave.	1997	4111
SE-53.1	Royalwood Subdivision	1993 1993	HF-4323 HF-4326
SE-58.1	St. Annes Rd.	1996 1997	LD-1654 LD-1655
FL-1	Deacon Reservoir	1996	D-4361
FL-2	Kildare Street	1981 1981	LD-528 LD-528

Table 2.2 - Outfall Inventory Summary

Stream	City Owned					Private	Totals
	≤300	> 300 and < 1200	≥1200	Channels	Ditches	All	
Red River	7	33	60	5	1	13	119
Assiniboine River	23	35	34	4	0	21	117
Seine River	18	31	12	2	1	3	67
Bunns Creek	2	13	9	0	2	0	26
Omand's Creek	21	3	1	1	0	0	26
Sturgeon Creek	2	18	6	0	0	0	26
La Salle River	2	2	0	0	0	0	4
Floodway	0	0	2	0	0	0	2
Totals	75	135	124	12	4	37	387

Notes:
1. RR72 Syndicate is connected to RR71, RR72 was not counted as an outfall in this table, but is included in the database as a connector pipe.
2. RR70.1, RR70.2 and RR70.3 are connected to RR70 - Watt Street. They are not counted as outfalls in this table, but are included in the database as connector pipes.
3. RR56.2 - Pioneer Blvd. is not included because it's a new installation 1997-98.

Table 2.3 - Outfalls not included in the Database

Outfall ID No.#	Name	Type	Size	Comments
RR-28.9	Victoria Crescent	LDS	?	Not Found
RR-29.5	Victoria Crescent	LDS	?	Not Found
RR-56.8	Provencher Blvd.	LDS	?	Not Found
RR-65	Boyle St. FPS	CS	1050	Abandoned
RR-66	Boyle St.	CS	900	Abandoned
RR-97A	Bergen Cut-Off	LDS	?	Abandoned
AS-16	Raquette	WWS	450	Abandoned
AS-84	Arlington Ave.	CS	350	Does Not Exist
AS-96	Assinibione Avenue	LDS	1100	Abandoned
AS-98	The Forks E. of CNR Bridge	CS	1500x1000	Abandoned
OM-27	Sherwin Road	LDS	450	Does Not Exist
OM-28	Notre Dame Ave. W,	LDS	450	Abandoned

SECTION 3.0
LBIS Update

3.0 LAND BASED INFORMATION SYSTEM (LBIS) UPDATE

The inventory review process described in Section 2.0 substantiated or contradicted the existing information contained in the City's Land Based Information System (LBIS). In some cases the information contained in LBIS was incomplete or incorrect. The WWD was informed that some discrepancies exist between LBIS and what has been inventoried. Changing or updating LBIS was not a requirement for the Outfall Condition and Maintenance study. A detailed list of required updates or changes to LBIS was prepared and forwarded separately for the City by KGS Group based upon the comparison of the existing LBIS data with the confirmed inventory data.

During the inventory review KGS Group identified several outfalls that were not recorded in LBIS. This information was forwarded to the WWD. The City added a portion of the missing outfalls to LBIS and provided KGS Group with the updated LBIS drawings and LBIS numbers for the outfalls. Consequently, LBIS number information was updated in the outfall database as described in Section 5.0. To-date several outfalls do not have an LBIS number, and are, therefore, assumed to be missing from LBIS database. Table 3.1 lists the outfalls identified by KGS Group during the inventory review process which do not have an associated LBIS number.

TABLES

Table 3.1 - Outfalls Not Contained in LBIS

Outfall ID No.	Name
RR-11	Radcliffe
RR-34.1	Kingston Row
RR-38	Cockburn St. FPS
RR-39	Cockburn St. Lift Station
RR-52	Marion St.
RR-55	Rue Despins FPD
RR-100	Whellams Lane
AS-1	WEWPCC (outside the perimeter)
AS-6	Barker SPS
AS-7	Caron Park
AS-23.1	Dieppe Rd. LDS
AS-60B	Chataway Blvd.
AS-67A	Route 90 Bridge
AS-76	Ash St. FPS
AS-86B	Maryland St.
AS-95	Assiniboine Ave. FPD
SE-7	Provencher Blvd.
SE-10	Rue Bourgeault
SE-17	Marion St. Bridge
SE-25	Dubuc St.
SE-58.1	St. Annes Rd.
ST-18.1	Hamilton Ave.
OM-10	Velodrome Metre Pit
OM-11	Velodrome
OM-12	Empress St.
OM-21	Empress St.
FL-1	Deacon Reservoir
FL-2	Kildare Ave.

SECTION 4.0 Outfall
Inspections

4.0 OUTFALL INSPECTIONS

4.1 Basis for Condition Assessment

The assessment of the outfall condition was assumed to be based upon three key interrelated aspects which may individually or coincidentally impact an outfall. For the Outfall Condition and Maintenance Study, the following conditions were considered to affect the performance of the outfall:

- The structural system of the outfall pipe - Structural;
- The hydraulic impacts of the stream on the outfall - Hydraulics;
- The stability of the riverbank as it relates to movement of the outfall - Geotechnical.

Other factors which could contribute to unsatisfactory performance include: sediment build-up inside the pipe, and obstructions caused by vegetative growth.

Having identified the key factors influencing the performance of a pipe, an assessment of the condition of the outfall could only be made once the proper information was collected. An inspection program was developed to ensure all data requirements were available when performing a condition assessment. The following data was to be collected during the inspection:

Structural

Physical Condition of the Pipe - A number of physical measurements and observations were taken to assess the physical condition of the pipe as outlined below. When possible the inspection of the outfall pipe was extended from the river bank up to the first structure (gate, weir, manhole, etc.). Physical data collected included:

- Deformation of the pipes (vertical, horizontal and diagonal)
- Cracking of the pipe and crack opening size/location
- Joint separations (opening, offset) and location (crown, base, side)
- Disturbance of invert alignment (upheaval, drop, side movement)
- Evidence of seepage into the pipe
- Loss of soil around pipe annulus, and voids or cavities outside the pipe
- Pipe disturbance caused by soil slumping and shear zones or soil scouring and erosion
- Corroded and pitted metal
- Concrete deterioration

Pipe Alignment - The outfall pipe was visually inspected for noticeable horizontal and vertical movements in the alignment of the pipe. Measurement of horizontal and vertical displacements were taken when possible. Longitudinal pipe deflection (Sag) was also measured where possible. It was originally proposed to survey the outlet invert elevations of all outfalls. However, the WWD requested that this work not be performed at this time. It may be appropriate to review the necessity of measuring the inverts, and perform the work if budgetary constraints allow it.

Ice Damage - Evidence of ice damage was noted, and commented on.

Hydraulic

Hydraulic Restrictions - Conditions which affect the hydraulic capacity of the outfall were noted. These included:

- partial collapse of the pipe due to movement of the pipe or from impact from ice or debris.
- a build up of sediment at the outlet which would cause a restriction to the capacity of the pipe
- severe restriction caused by vegetation growth downstream of the outlet.

Geotechnical

The methodology for the geotechnical assessment of riverbank stability consisted of:

- Detailed on site inspection of bank stability conditions by experienced geotechnical engineers.
- Review of Winnipeg Waterways Authority records of previous bank works constructed at or adjacent to each outfall.
- Air photo review of bank stability conditions at all outfalls.

On site inspections were not possible in the winter of 1996-1997 due to early and very heavy snowfalls, which masked any and all relevant ground features, even before award of the contract. All bank inspections were completed in October and November 1997, during and after the annual fall drawdown.

Bank stability features which were recorded on site included:

- Bank height
- Bank positions with respect to the river meander pattern
- Bank slope
- Any and all slope failure features including active or inactive headscarps, tension cracking in the bank surface, and humocky topography
- Erosion features such as toe scouring or undercutting of the bank
- The presence or condition of any existing bank protection works.
- The type of vegetation cover
- The presence of any existing slope stability instrumentation.

Inspection of existing Winnipeg Waterways Authority records for records of previous bank works in the vicinity of the outfall provided a valuable indication of which sections of riverbank have been historically stable or unstable. The Authority maintains records of all bank works completed under its jurisdiction since 1950. These records were used as a planning tool prior to initiating the on-site inspections.

Comprehensive air photo coverage of the riverbank conditions was obtained by the Winnipeg Waterways Authority in 1988 and 1992, each time during the winter drawdown period and with no foliage on the trees. The photos are an invaluable indicator of potential bank stability problems. Again air photo review was used as a planning tool prior to the on-site inspections.

The geotechnical assessments in this report utilize results from all three components of the methodology, but do rely most heavily on the actual site inspection.

The information obtained in the outfall inspection program was used to rate the condition of all the outfalls. The condition rating system originally developed by KGS Group included a 6 point rating system with a failure condition assigned a rating of 1, and a fully satisfactory condition assigned a rating of 6. The system developed by KGS Group was based upon the Ontario Ministry of Transportation condition rating system for the inspection of bridge and culvert crossings. Initial discussions with the Steering Committee lead to a revision of the rating system to coincide with the rating system being used by the Water and Waste Department for the condition rating of the sewer system network. Consequently, the rating system was revised to a 5 point rating system based upon the WRc[1] method for structurally rating sewer pipes. With the revised condition rating system, the failure condition was assigned a rating of 5, and the fully satisfactory condition was assigned a condition rating of 1.

Since it was recognized that the field inspections would be conducted by a number of different inspection teams, now and in the future, guidelines for rating the condition of an outfall were developed to ensure a consistent approach in obtaining the field data. The guidelines were based upon the ranking system for rating an outfall's structure, stream and riverbank conditions, and are given in Appendix B.

An overall condition rating for the outfalls was also developed. The criteria established for the overall rating is based upon the worst condition rating of the performance criteria considered. For example, if the structural condition is assigned a rating of 5, the stream condition is assigned a rating of 3, and the riverbank condition is given a rating of 3, then the overall rating would be

[1] Manual of Sewer Condition Classification, WRc, August 1993

assessed at 5 based on the worst condition rating found during the inspection. The procedure assumes that each of the performance categories (structure, geotechnical and stream) are equally important to the overall condition of the pipes performance. If any one of the categories is found to be at a failure condition, then the outfall is found to be in a failure condition.

4.2 Inspection Forms

An inspection form was developed for the field inspections to reflect the need for consistent data collection during the inspections of the outfalls. A sample form is included in Appendix B, and was used for all inspections performed by KGS Group personnel. As can be seen on the sample form, the following inspection information was included:

***Inspection Data*:**	Inspector's Name; Date of Inspection; Party Members; Air Temperature; Weather Conditions
***General Information*:**	Outfall Name; Location; Owner; Sewer Type; Stream
Physical Information:	Land Based Information System (LBIS) No.; Shape, Diameter (height and/or width); Length; Pipe Material; Invert Elevation; Sag; Grates
Pipe Hydraulics:	Deformation; Ice Damage; Hydraulic Restrictions
Geotechnical:	Bank Height; River Section; Slope; Slump; Erosion; Vegetation; Instrumentation
Condition Rating:	Structure CR; Geotechnical CR; Stream CR, General Comments.

The second page of the form consists of a structure condition crack mapping chart. The mapping was based upon a 12 hour clock position referenced as the ordinate, and the distance from the outfall end of the pipe as the abscissa to reference any cracks, spalling, displaced joints or other anomalies associated with the structural condition of the pipe. All the mapping charts created in the field were then reproduced digitally using AUTOCAD©. Copies are included in Appendix C.

A number of the outfalls between 300 and 1200 mm diameter were inspected by closed circuit televising and recorded on VHS video format. The televised videos were reviewed, notes taken, and transferred directly to the database. A subsequent field survey and geotechnical assessment for all outfalls televised was conducted by KGS Group, and the information was recorded on the inspection forms.

4.3 Inspections

It was originally proposed to have all the outfall inspections performed in one low water season. Typically the rivers and streams through Winnipeg experience lower flows and water levels after the fall "drawdown" when the gates at Lockport are opened (usually mid-October). Upon authorization to proceed, KGS Group initiated the structural inspections of the outfalls. The 1996/97 inspections were hampered, however, by early and record snow falls and high water/ice levels in the Red and Assiniboine Rivers. For this reason, KGS Group was authorized to perform the inspections over two low water seasons.

The outfall inspection program was completed by December 1997. All accessible outfalls were inspected to determine the structural condition of the outfall pipe, and all outfalls greater than 300 mm diameter (as directed by the WWD) were inspected to assess geotechnical and stream conditions. Table 4.1 provides a listing of the number outfalls which were inspected, and categorized by owner, size and stream. A complete listing of all the outfalls inspected is presented by Phase in Appendix D. As can be determined from the table, 75 percent of those outfalls required to be inspected by CCTV (101 of 135) were completed, and 66 percent of those required to be physically inspected (81 of 124) were completed. In total, 71 percent of the outfalls (182 of 259) were inspected. Additionally, 16 outfalls, 9 smaller than 300 mm diameter and 7 designated as privately owned, were also inspected and recorded during the study.

Of those outfalls not inspected during the study, a majority could not be inspected because the outfall pipe was partially or completely submerged. In some cases the submergence was due to above normal water levels, and in others, the outfalls were designed to be submerged, especially those outfalls which are part of the City's land drainage sewer system or on the north side of the Assiniboine River and west of the St. James Bridge. A small portion of the outfalls could not be accessed, due either to their location or type of sewer (ie., treated sewage). Two outfalls were not inspected because of severe sediment/debris build up inside the pipe. Table 4.2 categorizes those outfalls which were not inspected by size, stream and reason for not being inspected. A complete listing of those outfalls not inspected is provided in Appendix E. A prioritized list and methodology for inspecting the remaining outfalls could be developed under the present budget or a future project budget.

In general, the inspections performed consisted of personal - "walk through" - visual inspections for outfalls greater than 1200 mm in diameter, or recorded inspection by closed circuit television (CCTV) for outfalls between 300 and 1200 mm in diameter. All pipes inspected physically or by CCTV were recorded on VHS video format, and photographs (included with the submitted CCTV reports) of distressed areas were taken. The video tapes have been forwarded to the WWD with this report. A complete index of the tapes is provided in Appendix F. All inspected outfalls are listed by tributary and name, and the tape index and recorded time interval (in minutes from the beginning of the tape) are given.

The condition information noted was recorded on the Inspection Forms described in Section 4.2. The visual inspections facilitated an assessment of the outfall pipe's structural condition. As well, the bank conditions and the streams impact on the outlets were inspected and assessed via boat and visual inspection. Throughout the inspection process, WWD personnel assisted KGS Group with opening locked gate chambers and pumping stations, removing outlet grates, and locating manholes. A description of each phase of the inspection process is presented below.

Phase 1 (1996-97)

In November 1996 KGS Group commenced the inspections, which focussed primarily on the outfalls located on the Red and Assiniboine Rivers. A preliminary list of outfalls in poor condition was submitted to the Steering Committee in December, 1996. The most notable, of which, was "RR-15 - Rivergate Dr." which the City reviewed and considered redundant.

A visual inspection of the outfall and bank stability conditions along the Red River within Winnipeg, and on the Assiniboine River downstream (east) of the Maryland Bridge was completed on November 4, 1996. The inspection was performed by Mr. Brian Bodnaruk, P. Eng., Senior Hydraulic Engineer, and Mr. Mark Jamieson, P. Eng., Senior Geotechnical Engineer, of KGS Group in a boat provided by the City of Winnipeg Harbour Master, Joe Pietracci. Shallow water depths did not permit boat passage upstream of the Maryland Bridge. At the time of the inspection, the river was drawn down to its natural winter level (221.5 metres at James Avenue), approximately 1.7 m below the regulated summer river level. Photographs (see Photo Log submitted with this report) and video (submitted to WWD with this report) were taken of the majority of the outfalls to provide a permanent record. The inspection from the river allowed investigation of the shoreline conditions of both the riverbank and the exit of the outfall. Particular attention was given to the riverbank stability and erosion conditions, as well as the condition of the visible portion of the outfall at each location.

The structural inspections for larger pipes was performed by two man inspection teams. One member of the inspection team accessed the outfall pipes via the first upstream manhole or the outlet. The inspector recorded the information on the forms, and the other party member acted as a safety watch.

A total of 121 outfalls were inspected during Phase 1. This included: 65 inspections of outfalls 1200 mm diameter or greater; 40 videotaped inspections of outfalls between 300 and 1200 mm diameter; 9 videotaped inspections of outfalls 300 mm diameter or less; and 7 private outfalls. KGS Group was forced to abandon the "walk through" structural inspections in mid January 1997 due to very large snow accumulations and a winter river level that was approximately 2.0 feet higher than normal.

UniJet Industrial Pipe Services Limited was subcontracted to perform the inspections by CCTV. The outfall pipes were accessed via the first upstream manhole or from the outlet. Upon completing several inspections UniJet forwarded inspection reports and video tapes to KGS Group. The inspection reports and videos were reviewed by KGS Group and the outfalls were rated according to the rating guidelines.

KGS Group discontinued televising outfalls in mid December 1996. This was due to the difficulty in locating the manholes under the large snow accumulation. Even with the combined effort of KGS field staff and City of Winnipeg crews, locating and marking the manhole locations proved to be too difficult. Frozen locks at pumping stations and ice accumulation in pipes were also major problems.

Phase 2 (1997-98)

In September 1997, KGS Group initiated the second phase of the outfall inspection program. An overall inspection of all of the outfalls was performed to determine which were accessible. This included a boat assisted reconnaissance visit by KGS Group geotechnical engineers to all locations of outfalls greater than 300 mm. Photographs were taken from the river of each outfall and its overall bank condition. River bank stability and erosion conditions were assessed and rated according to the guidelines outlined in Section 4.1.

Inspection teams were increased to three members for the "walk through" inspections during the second phase to comply with the Workplace Health and Safety and the City of Winnipeg's Regulations for Confined Space Entry. The inspector would access the outfall, while the other two members remained above ground. While descending down the Manhole, the inspector was connected to a safety tripod. The inspector was required to wear a self contained breathing apparatus, a safety harness, and a "life line" while performing the inspections. The inspector would complete the inspection forms, videotape and photograph the pipe. The second and third members of the team were situated at the pipe outlet and the access manhole while the inspector was in the pipe in case of emergency. The safety equipment used was portable but cumbersome, which slowed the progress of the inspections considerably. With this procedure adopted in the second phase, each crew was only able to inspect two outfalls per day maximum, where during the first phase, a two man crew was able to inspect up to five outfalls in one day.

The remaining 77 outfalls inspected were completed during Phase 2. This included 17 physical inspections of outfalls 1200 mm diameter or greater, and 60 videotaped inspections of outfalls between 300 and 1200 mm diameter. River levels were approximately 1.5 to 2.3 feet higher than normal which prevented further inspection of the outfalls identified as submerged.

Once again UniJet Industrial Pipe Services was subcontracted to televise the outfalls. This work was coordinated by KGS Group, which marked out manhole locations and provided UniJet with a list of outfalls to be inspected. Once completed, inspection reports and videos were reviewed by KGS Group, the outfalls were rated according to the guidelines.

TABLES

Table 4.1 - Summary of Outfalls Inspected

Stream	City Owned			Private	Totals
	≤300	> 300 and < 1200	≥1200	All	
Red River	3	25	48	2	78
Assiniboine River	6	31	21	5	63
Seine River	0	19	3	0	22
Bunns Creek	0	7	4	0	11
Omand's Creek	0	3	0	0	3
Sturgeon Creek	0	14	3	0	17
La Salle River	0	2	0	0	2
Floodway	0	0	2	0	2
Totals	9	101	81	7	198

Notes:1.RR70.1, RR70.2 and RR70.3 are connected to RR70 - Watt St. All are recorded as one outfall in this table.
2.RR72 is connected to RR71 - Syndicate. These pipes are recorded as one outfall in this table.

Table 4.2 - Summary of Outfalls Not Inspected

Stream	Submerged		No Access		Sediment Build-Up		Totals
	> 300 and < 1200	≥1200	> 300 and < 1200	≥1200	> 300 and < 1200	≥1200	
Red River	3	9	4	2	1	1	20
Assiniboine River	2	12	2	1	0	0	17
Seine River	12	9	0	0	0	0	21
Bunns Creek	6	5	0	0	0	0	11
Omand's Creek	0	1	0	0	0	0	1
Sturgeon Creek	3	3	0	0	1	0	7
La Salle River	0	0	0	0	0	0	0
Floodway	0	0	0	0	0	0	0
Totals	26	39	6	3	2	1	77

PROPERTY
OF THE
WATER & WASTE DEPARTMENT
RESOURCE CENTRE
1500 PLESSIS ROAD

SECTION 5.0
Information
Management System

SECTION 5.0
Information
Management System

5.0 INFORMATION MANAGEMENT SYSTEM

5.1 General

As part of the Outfall Condition and Maintenance Study, KGS Group developed a computerized information management system (IMS), or database, for all known sewer outfalls within the City of Winnipeg. The database provides a comprehensive record of inventory and inspection information gathered by KGS Group for the outfalls. The database is to be used as an operational tool, and as a means of storing and retrieving the outfall condition information collected. As well, the IMS can be used to facilitate historical tracking of data for inspection and maintenance planning for each outfall. The outfall database is set up with a "user friendly" interface to allow novice computer users a means of entering, updating, searching, displaying and reporting data for each outfall.

Development of the database was completed with input from the Steering Committee. The preferences for the user interface, data to be included in the database, and data presentation was developed during consultations with the Steering Committee. As well, CG&S Consultants were consulted for additional advice on the database development and programming preferences including the data structure.

It was originally proposed to use the *BORLAND PARADOX*© database software because it was being used in a similar study of the City of Winnipeg Aqueduct. However, during the development of the database, *MICROSOFT ACCESS*© was recommended by KGS Group and agreed to by the Water and Waste Department since it was a more familiar tool to the department's personnel.

The IMS was programmed using *MICROSOFT ACCESS 7.0*©. This relational database tool allows development of a full featured user interface, which can be customized to any user preference. Users of the database utilize the convenient forms for manipulating the database, and do not have to work with complex table structures for input or data presentation. The database structure can be customized by an experienced database programmer using the table, form, query and report functions.

5.2 Outfall Database

The outfall database features forms for entering, updating and searching for data. The user is provided access to the underlying data table structure through the "user friendly" forms which are presented in similar manner to the inspections forms. This allows the user to input and update data in a consistent fashion. Searching through the database is also facilitated by allowing the user to specify a number of search criteria. As well, predefined reports can be viewed and printed by the user. A comprehensive and detailed explanation of the database, its tables, forms, reports, and use is included in the database manual which is attached to this report as a separate document. A brief discussion of the major features of the IMS is given below.

The IMS consists of three overall modules, specifically: The Data Entry module, the Data Update module, and the Database Search module. All modules are controlled from a main menu. Data Entry is used for inputting new data for an outfall which has not yet been identified in the database. Data Update is a tool for changing previously entered data or entering new inspection data for an outfall which already exists within the database. The searching tool can be used to find specific outfalls in the database which match given criteria. The Search Utility can be used to identify a set of outfalls, or a particular outfall which may need to be updated. Two reports are available at different stages throughout the search process. Each can be printed for hard copies if the search is successful.

The intent of the IMS is to facilitate the collection of the inspection information for all outfalls through time. The database is organized such that the general information about an outfall, such as the Name, Location, Outfall ID No., Sewer Type, Size, Shape, Material Type etc., remains relatively fixed through time. The specific inspection data information, which is subsequently gathered, is then linked to the more general information. Each inspection is indexed and stored in the database, so that a history of the condition of a particular outfall can be tracked through time. The inspection information is categorized and organized in the IMS in a similar manner to that which appears on the inspection form including the Inspection Party, Pipe Hydraulics, Geotechnical, and the Condition Assessment.

The Outfall Study database can also be linked to the City's Land Based Information System (LBIS) through the LBIS number. For those pipe segments with an associated LBIS number, each can be linked to the LBIS system. Integrating the two systems through this link was not considered as part of this study.

Where possible, tasks were automated to accelerate data entry, and default or "pulldown" lists were presented to the user to maintain consistency in the data. For example, the user is presented with the following list of default choices for Pipe Restrictions:

- Partial collapse of pipe
- Sediment built up in the pipe
- Severe restriction caused by vegetation

As described in Section 2.0, the database submitted to the WWD contains information for 387 different outfalls, of which, 349 fall under the responsibility of the WWD, and 37 are categorized as privately owned outfalls. As indicated in Section 4.0, inspections were completed for approximately 71 percent of the outfalls that were required to be inspected. The inspection and condition assessment information for these outfalls has been entered into the database.

5.3 Outstanding Issues

The database does not have any built-in password security. Authorization for use of the database could be invoked at either the Administrator level and/or the User level. The administrator would have a separate password to use the database, enter data, manipulate the data, forms, reports or tables. The user would have a unique password (ie., many users with one general password). Users would only be able to interact with the database through the forms developed. They would not be able to manipulate the data within specific tables, and they would not be able to change the forms, reports or other database structures. This level of security was recommended to the Steering Committee. It was decided, however, not to implement the security at this time because the personnel responsible for administering and using the database will be responsible for initiating the desired level of security.

The reports generated by the database are generic and have broad scope. The WWD may find it necessary to develop more specific reports from the database after using the IMS and determining its functionality. As stated above, the reports can be tailored to meet any end users needs, and can be created by an experienced programmer familiar with *MICROSOFT ACCESS*©.

SECTION 6.0
Condition
Assessment

6.0 CONDITION ASSESSMENT

As mentioned previously, approximately 182 of the required 259 outfalls under the responsibility of the WWD have been inspected and assessed for their present condition. Of these outfalls 71 have been assigned a failure condition rating of 5. The rating is based upon the structural condition of the pipe, as well as the geotechnical and hydraulic (stream) condition of the bank as discussed in Section 4.0. The ratings have been categorized in Table 6.1 according to the reason for the failure rating and by stream. In some cases, an outfall was assigned a failure rating of 5 for two or more of the categories. For example, "RR-24 - Falconer Bay" was assessed to have failed on all three categories of structure, geotechnical and stream ratings. The table below also lists the number of outfalls with more than one failure rating according to the possible combinations of the three categories (ie., Structure, Geotechnical & Stream - All, Structure & Geotechnical - (1) & (2), Structure & Stream - (1) & (3), Geotechnical & Stream - (2) & (3).

As can be seen in the table the majority of failures occur as a result of structural problems with the pipes. Further analysis of the data, reveals that 56 percent of the failures have occurred in outfalls between 300 and 1200 mm diameter. Table 6.2 categorizes the number of failures by sewer type. As can be seen the majority of the outfalls that have failed are part of the City's land drainage system. These statistics will provide a basis for planning the rehabilitation of the outfalls, which is discussed further in Section 7.0

It is noted that 6 of the 9 outfalls inspected that are less than or equal to 300 mm diameter were found to be in a failed state. This is a significant percentage which may warrant the remaining 65 outfalls in this category to be inspected.

6.1 Structural Condition Ratings

For each of the outfalls that were required to be inspected, structural ratings were assessed according to the guidelines described in Section 4.0. Table 6.3 lists the distribution of structural ratings according to tributary. As can be seen a total of 77 outfalls were unable to be rated for their structural condition as these outfalls were not inspected (see Section 4.0). The ratings were based upon the review of the inspection data collected during the "walk through" and CCTV inspections. The assessments were made according to the information contained on the available structure condition crack mapping charts, notes, and observations made during a review of the video taped inspections.

As can be seen on the table the ratings are distributed throughout the range, but the largest percentage (30%) of the outfalls have been assigned a rating of 5. The majority of the failed outfalls had significant defects throughout the entire length of the outfall. The most common problem was found to be open and displaced joints horizontally and vertically. This condition was often coincidental to sediment buildup and root infiltration. Cracking and pipe deterioration was the second most common problem, and only two outfalls were found to be on the verge of total collapse.

Of the outfalls inspected, 8 had major defects in specific locations only. "Spot" repairs could be performed on these outfalls to remedy the situation without having to totally rehabilitate the entire length of pipe. As well, one outfall was noted as having a failed condition throughout the length of the pipe at the majority of the joints. These joints could be repair internally and extend the life of the outfall without significant capital expenditure. The extent of the failure and nature of the required repair were taken into account when the costs were estimated (see Section 7.0).

For the remaining outfalls not rated 5 structurally, a monitoring program will be established. The program will involve a routine of inspections with higher priority given to outfalls structurally rated 4 than those rated 1. An effective operations and maintenance program would reduce future capital upgrade costs, or at least make more effective and timely use of capital resources. The required operations and maintenance program is discussed in more detail in Section 8.0

6.2 Geotechnical Condition Ratings

Geotechnical condition ratings were assigned each outfall greater than 300 mm in diameter according to the methodology described in Section 4.1. Table 6.4 lists the distribution of geotechnical ratings according to tributary. A total of 256 outfalls have been rated as part of this draft report. The remaining 3 outfalls were not inspected due to submergence of the outlet or problems in locating the outlet.

As shown on Table 6.4, the ratings are skewed to the 1 and 2 ratings, with 75% rated as 1 or 2. The remainder are found as 16.0% rated as a 3, 6.0% rated as 4, and 2% rated as 5. Of those rated 4 or 5, the most common problem was active bank failures and/or significant overall bank erosion.

The low percentage of outfalls with a geotechnical bank rating of 4 or 5 was not expected at the onset of this study. The low percentage is attributed primarily to the outfall reconstruction program implemented by the City of Winnipeg in the 1980's and 1990's, which focussed on the larger diameter outfalls in the worst condition. Many of those outfalls were located on the banks of unstable outside bends where erosion, undercutting, slumping and retrogressive bank movements had undoubtedly contributed to the poor condition of the outfall. In each case, significant bank stabilization works were completed as part of the outfall repair with the result being few outfalls remaining in poor condition (geotechnical rating of 4 or 5) as was reflected by the geotechnical inspection results.

6.3 Stream (Erosion) Condition Ratings

Erosion condition ratings are summarized on Table 6.5. Again the majority of the stream condition ratings, 52 % were ranked as category 1 or 2, 21 % were ranked as category 3, 18 % were ranked as 4, and 8 % were assigned a 5 rating.

The lower percentage of outfalls rated as 4 and 5 is again attributed to the extensive bank works in the 1980's and 1990's constructed around many outfalls on outside bends.

TABLES

Table 6.1 - Summary of Outfalls with Failure Rating

Stream	Structure Only (1)	Geotech. Only (2)	Stream Only (3)	(1) & (2)	(1) & (3)	(2) & (3)	All	Total
Red R.	21	0	5	0	4	1	1	32
Assiniboine R.	20	0	0	0	0	0	0	20
Seine R.	1	2	0	0	0	0	0	3
Bunns Cr.	1	0	3	0	0	0	0	4
Omand's Cr.	1	0	0	1	0	0	0	2
Sturgeon Cr.	1	0	5	0	2	0	0	8
La Salle R.	0	0	0	0	0	0	0	0
Floodway	2	0	0	0	0	0	0	2
Totals	47	2	13	1	6	1	1	71

Table 6.2 Failures of Outfalls by Sewer Type

Sewer Type	Number of Failed Outfalls	Percentage of Total Failed
Land Drainage Sewer	47	66.2
Combined Sewer	20	28.2
Waste Water Sewer Overflow	4	5.6
Totals	71	100

Table 6.3 - Structural Condition Ratings Summary

Stream	Structural Rating						Total
	1	2	3	4	5	Not Rated	
Red R.	16	16	8	7	26	20	93
Assiniboine R.	12	6	9	5	20	17	69
Seine R.	4	7	7	3	1	21	43
Bunns Cr.	4	3	3	0	1	11	22
Omand's Cr.	0	0	0	1	2	1	4
Sturgeon Cr.	1	3	8	2	3	7	24
La Salle R.	0	2	0	0	0	0	2
Floodway	0	0	0	0	2	0	2
Totals	37	37	35	18	55	77	259

Table 6.4 - Geotechnical Condition Ratings Summary

Stream	Geotechnical Rating						Total
	1	2	3	4	5	Not Rated	
Red R.	38	30	17	6	2	1	93
Assiniboine R.	4	54	8	2	0	1	69
Seine R.	12	21	4	4	2	0	43
Bunns Cr.	9	2	9	2	0	0	22
Omand's Cr.	0	3	0	0	1	0	4
Sturgeon Cr.	14	4	3	2	0	1	24
La Salle R.	1	1	0	0	0	0	2
Floodway	1	1	0	0	0	0	2
Totals	79	116	41	16	5	3	259

Table 6.5 - Stream Ratings Summary

Stream	Stream Rating						Total
	1	2	3	4	5	Not Rated	
Red R.	13	11	37	19	11	2	93
Assiniboine R.	29	24	6	9	0	1	69
Seine R.	27	8	4	4	0	0	43
Bunns Cr.	6	5	3	5	3	0	22
Omand's Cr.	0	3	0	1	0	0	4
Sturgeon Cr.	2	3	3	8	7	1	24
La Salle R.	2	0	0	0	0	0	2
Floodway	2	0	0	0	0	0	2
Totals	81	54	53	46	21	4	259

SECTION 7.0
Recommended
Capital Upgrades

7.0 RECOMMENDED CAPITAL UPGRADES

Based upon the assessed conditions for each outfall, estimates for required capital upgrades and the associated costs were determined. The required upgrades have been categorized and prioritized to facilitate scheduling the requirements within budgetary and resource constraints. It is assumed that all major construction would be contracted out. The estimated costs are based upon KGS Group's experience with similar work, and discussions with local contractors, such as Nelson River Construction, Borland Construction and Uni-Jet Industrial Pipe Services having sewer rehabilitation and maintenance expertise.

The Water and Waste Department is currently addressing several concerns with identified problem outfalls. Additionally, several outfalls are currently being independently studied as part of the Combined Sewer Relief Projects or other infrastructure works such as the Provencher Bridge Replacement. The department has also identified one outfall as being redundant, and as such, this outfall was not considered for any repairs or maintenance. Table 7.1 lists the outfalls which are currently being addressed or otherwise are not considered for remedial work in this study even though they have been assessed an overall condition rating of 5.

7.1 Outfalls Requiring Structural Repairs

A total of 50 outfalls have been identified as requiring rehabilitation due to the structural failure of the pipe. Of these, 2 are discharge pipes from flood pumping stations (FPD or FPS), 6 are waste water sewer overflows (WWSO), 13 are combined sewer overflows (CS), and 29 are outfalls of the land drainage system (LDS).

Additionally 5 outfalls appear in the discussion below, and have an associated estimated cost assigned to them. The cost is, however, estimated based upon replacement of the existing pipe which may be subject to change depending upon the results of the Combined Sewer Relief Studies conducted and the scheduling of the Provencher Bridge Replacement Project.

Each outfall was assessed for the required repair work, and an estimated cost was assigned to each. Costs were also estimated to repair those outfalls rated 5, but smaller than 300 millimetres in diameter. Several of these outfalls were inspected and rated before the department directed KGS Group to concentrate on the larger pipes. For this reason the smaller pipes are included in the required structural repair estimate.

Table 7.2 lists the outfalls categorized as above, and prioritized according to risk of damage associated with total failure of the pipe. It is assumed that the FPDs are critical to minimize the chance of sewer backup during flood periods, and they are given the highest priority for repair. The next priorities were the overflow outfall pipes of the waste water and combined sewer systems respectively. The lowest priority was given to the repair of the land drainage sewer outfalls because the consequence of failure is not considered to be as significant. Priorities were also based on pipe size which was considered to be correlated to the amount of risk, assuming that larger pipes service larger areas and greater damage would result from their failure.

The table also shows the estimated costs to repair those outfalls rated 5, but smaller than 300 millimetres in diameter.

The costs shown in Table 7.2 are based upon current pricing of replacement materials from local suppliers, and installation included the excavation, bedding and backfill (1998 dollars). For purposes of this study it was assumed that the outfall pipes were to be replaced by new pipes of the same size and material. Further review of this assumption would be necessary at the design stage to optimize costs and design life of the rehabilitated outfalls. For the majority of the outfalls, the estimates include replacement of the entire length of pipe from the outlet to the first structure upstream. "Spot" or internal repairs for concentrated failure sections of pipe are noted where applicable.

Access to the site was also considered and costs were assessed based on the distance from the nearest river access point to the outfall. A premium was added for dewatering those outfalls that were submerged. This included an allowance for cofferdams, and pumping. The estimated repairs also took into consideration the restoration of the site, which was estimated to be $7.50 per square metre for new top soil and grass sod and $5.00 per square metre for new top soil and hydro-seeding. A detailed estimate of costs for the outfalls is included in Appendix G.

The total cost of $2,138,000.00 dollars for the rehabilitation of all the recommended outfalls is to be phased in over a 5 year period. The phasing of the repairs would coincide with other routine maintenance and inspection. A detailed discussion of the phasing of the repairs is provided in Section 9.2

7.2 Outfalls Requiring Bank Stability Repairs

Table 7.2 identifies a total of $565,000 in upgraded erosion protection estimated to be required as part of the reconstruction of outfalls with a structural rating of 5. The bank repairs are estimated to consist of riprap blankets or upgrading to existing riprap blankets. The intent is to significantly reduce lower toe erosion, the overall driving force behind most bank instability. Estimates were prepared on the basis of current market prices for riprap in place, which is approximately $30 per cubic metre.

Section 6.2 had identified a total 5 outfalls which were assigned a geotechnical rating of 5 (bank could fail at any time). Two of those four were dealt with under Table 7.2, and the other is RR-24 (Falconer) which has been scheduled for rehabilitation in 1998. The remaining two are SE-27 (Evans) and SE-39 (Morrow), both having a structural ratings of 1 or 2. On the one hand, the outfall pipes are in good structural condition (Pipe at SE-39 has recently been replaced). On the other hand, there is very direct evidence on site, that the bank may slump or fail at any time. Recommendations for rehabilitation alternatives for outfall replacements at locations where the riverbank is unstable are based upon an economic analysis. The following section presents this methodology for both SE-27 (Morrow) and SE-39 (Evans).

7.3 Economic Analysis of Rehabilitation Alternatives

A methodology for an economic analysis to compare rehabilitation alternatives of outfalls on unstable banks was developed by KGS Group, and reviewed by WWD, during the study (see the attached memorandum, date December 5, 1997, Appendix H). The memorandum presents two scenarios in which the justification for bank stabilization works, as opposed to rehabilitating the outfall pipes after a recurrence of a bank failure, is assessed. The first scenario considered that the consequence of bank failure is limited to the loss of the outfall, and there is no other significant economic impact such as flooding upstream due the pipe failure. The second scenario considered that additional loss would occur as a result of the bank failure. Additional losses beyond the direct damage to the outfall could include the loss of a flood pump station, and subsequent basement flooding upstream, and/or other important infrastructure works such as a street.

If there is no significant additional loss beyond the outfall pipe, the decision to proceed with bank stabilization works is made on the comparison of the present value of the cost of the bank stabilization works to the cost of the required pipe repairs during the expected life of stabilization measures.

When the risk of the loss of a flood pump station or other significant asset is considered, a benefit/cost ratio of annualized damages versus the costs of stabilization is assessed. Damages and costs are based upon the probability of bank failure combined with a significant rainstorm, and the associated damages (Loss of infrastructure and flood damages).

Both scenarios require the following data for the assessment:

- cost of the bank stabilization
- life expectancy of the bank stabilization works
- the frequency of which the bank is expected to fail, and
- the cost of the pipe rehabilitation works

As well, the second scenario also requires the following data:

- the consequences, in terms of damage to an FPS and potential district flooding if the FPS is out of service during a significant spring rainfall event where the pumps are required.

Both SE-27 (Morrow) and SE-39 (Evans) are part of the land drainage system, and the consequence of the bank failure is considered to be primarily limited to the loss of the outfall. The outfalls and adjacent bank conditions are considered to be similar, and the following economic factors were considered for the purpose of the evaluation:

- Bank stabilization costs range from $300,000 to $350,000
- Life expectancy of the bank stabilization works ranges from 30 to 50 years
- The frequency of which the bank is expected to fail ranges from 5 to 10 years
- The cost of the pipe rehabilitation works ranges from $40,000 to $60,000
- The discounted interest rate was assumed to be 5%

The above economic parameters were considered for the present value assessment and a sensitivity analysis for the range of parameters was conducted. Table 7.3(A) and Table 7.3(B) list the calculated present value of the pipe repair costs for an expected life span of 50 and 30 years respectively.

As can be seen by the tables, the present value of anticipated pipe repair costs ranges from $85,000 to $246,000 for all conditions. All values are less than the estimated initial expenditure of $300,000 to $350,000 for bank stabilization works. It can be concluded that, on this basis, the bank stabilization measures for SE-27 and SE-39 are not justifiable. That is, it would be more cost effective to make repairs to the outfall pipe at the anticipated frequency over the life expectancy of the stabilization works than it would be to perform the bank stabilization measures.

Outfall SE-27 (Evans) is located at the corner of Evans and Cusson Street, and the City has decided to barricade the street corner adjacent to the outfall because traffic loading could induce a slope failure. Homeowners in the vicinity must access their property via Cote or Deniset Street. Outfall SE-39 (Morrow) is situated between to two medium sized apartment buildings, and concerns of property damage associated with the unstable bank have been identified.

It is recommended that the City pursue the feasibility of cost sharing bank stability works with the adjacent stakeholders as was done for outfall, RR-24 (Falconer Bay). RR-24 failed because of its location on an unstable bank. The City is currently rehabilitating the outfall pipe, and the adjacent river bank as part of a negotiated cost sharing project. The adjacent residents have agreed to contribute funding to justify the total capital expenditure for the bank stabilization. If a similar arrangement can be negotiated with the adjacent stakeholders near SE-27 and SE-39 bank stability works should be re-evaluated. Negotiations could be based upon further economic analysis that would apportion property/infrastructure losses for both public and private stakeholders against the construction costs. Since each outfall location has specific requirements for rehabilitation, and the adjacent land ownership is also unique, each cost sharing project would have to be negotiated separately. No generic formula for apportioning the responsibility can be produced because of the number of factors involved in the negotiations.

TABLES

Table 7.1 Outfalls Not Considered for Remedial Work

Outfall Id No.	Outfall Name	Tributary	Size (mm)	Sewer Type	Comments
AS-12	Glasworthy Place	Assiniboine River	450	LDS	Scheduled for Rehabilitation in 1998
AS-14	Coleridge Park Drive South	Assiniboine River	450	LDS	Scheduled for Rehabilitation in 1998
RR-15	Rivergate Drive	Red River	1350	WWSO	Considered Redundant by WWD
RR-17	Minnetonka	Red River	2100	LDS	Scheduled for Rehabilitation in 1998
RR-24	Falconer Bay	Red River	1200	LDS	Scheduled for Rehabilitation in 1998

Table 7.2
Repair Cost Estimate for Outfalls with Structural Rating 5

Outfall ID#	NAME	Pipe size (mm)	Total Estimated Cost For Pipe Repairs	Total Estimated Cost For Erosion Protection	Total Estimated Cost	Comments
Pumping Stations and Flood Pumping Stations						
AS 74	Clifton Street FPD	2100	$ 62,000	$ 10,000	$ 72,000	Requires Rip Rap
RR 51	Marion Street FPD	1600	$ 47,000	$ 10,000	$ 57,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 55	Rue Despins FPD	1200	$ 37,000	$ 10,000	$ 47,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 60	Rue La Verendrye	600	$ 10,000	$ 25,000	$ 35,000	"Spot" repair 5 m; Pipe has shifted. Requires Rip Rap
	Subtotal		**$ 156,000**	**$ 55,000**	**$ 211,000**	
Waste Water Sewer Overflow						
RR 100	Whellams Lane	1200	$ 10,000	$ 10,000	$ 20,000	Requires Rip Rap
AS 23	Dieppe Road	650	$ 7,000	$ 5,000	$ 12,000	Incomplete inspection another cmp runs through pipe. Requires Rip Rap
RR 3	St. Norbert X-Kalay Lift Station Overflow	300	$ 15,000	$ 10,000	$ 25,000	Requires Rip Rap
AS 9.9	Sheir Dr.	250	$ 7,000		$ 7,000	
AS 26	Ridgedale S.P.S.	250	$ 11,000		$ 11,000	"Spot" repair 10 m; Side of CMP pushed in
AS 8	St. Charles Street 1	250	$ 8,000		$ 8,000	
	Subtotal		**$ 58,000**	**$ 25,000**	**$ 83,000**	
Combined Sewer Overflow						
RR 79	Hart Ave	2850	$ 78,000	$ 25,000	$ 103,000	Requires Rip Rap
AS 42	Conway CS	2500	$ 282,000	$ 50,000	$ 332,000	Requires Rip Rap
AS 61	Doncastor Street	2250	$ 145,000	$ 25,000	$ 170,000	Requires Rip Rap
AS 81	Ruby St. 1	2100	$ 51,000	$ 10,000	$ 61,000	Requires Rip Rap
AS 90	Colony Street	1800	$ 76,000	$ 25,000	$ 101,000	Requires Rip Rap
RR 52	Marion Street	1800	$ 60,000	$ 10,000	$ 70,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 90	Linden Ave.	1800	$ 30,000	$ 5,000	$ 35,000	Requires Rip Rap
RR 54	Rue Despins	1400	$ 41,000	$ 5,000	$ 46,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 58	Rue Doumoulin	1060	$ 29,000	$ 5,000	$ 34,000	Replacement cost only. Pricing is subject to replacement as part of the Future Provencher Bridge project. Requires Rip Rap
RR 96	Larchdale Cres. SPS	1050	$ 19,000	$ 10,000	$ 29,000	Requires Rip Rap
AS 37	Strathmillan Road	900	$ 23,000	$ 25,000	$ 48,000	Outfall is Submerged. Requires Rip Rap
AS 91	Kennedy Street	760	$ 36,000		$ 36,000	
AS 93	Hargrave Street	700	$ 24,000		$ 24,000	"Spot" repair 5 m; Pipe has shifted
AS 29	Woodhaven Blvd.	450	$ 38,000	$ 5,000	$ 43,000	Requires Rip Rap
RR 37	Calrossie Blvd	450	$ 14,000	$ 10,000	$ 24,000	Requires Rip Rap
AS 83	Arlington Street 1	375	$ 12,000		$ 12,000	Includes an extra 15m section to extend outfall into the river
	Subtotal		**$ 958,000**	**$ 210,000**	**$ 1,168,000**	

Land Drainage Sewer						
FL 2	Kildare at Floodway	3000	$ 257,000	$ 25,000	$ 282,000	Requires Rip Rap
ST 3	Booth Drive	1850	$ 28,000	$ 5,000	$ 33,000	Requires Rip Rap
AS 16.1	Raquette street 2	1800	$ 51,000	$ 5,000	$ 56,000	Requires Rip Rap
AS 19	Carroll Road	1800	$ 105,000	$ 30,000	$ 135,000	Requires Rip Rap
RR 7	Cloutier Drive (Segment 1 & 2)	1800/900	$ 48,000	$ 10,000	$ 58,000	"Spot" repair 5 m on Segment 1. Requires Rip Rap Repairs
RR 103	Valhalla Drive	1675	$ 50,000	$ 10,000	$ 60,000	Requires Rip Rap
FL 1	Deacon Reservoir	1500	$ 29,000		$ 29,000	Majority of the joints have started to separate, some > 25mm, Assume $15,000 to grout shifted joints
RR 31	Dunkirk Drive	1400	$ 23,000	$ 20,000	$ 43,000	Requires Rip Rap
AS 18	McCallum Cres.	1350	$ 12,000		$ 12,000	"Spot" repair 5 m; Outlet is damaged
RR 59	Rue La Verendrye	1200	$ 35,000	$ 25,000	$ 60,000	Requires Rip Rap
AS 10	Pender Street	900	$ 12,000		$ 12,000	"Spot" repair 5 m; Pipe outlet has some ice damage
RR 28	Dowker Ave. Outfall	900	$ 13,000	$ 10,000	$ 23,000	Requires Rip Rap
RR 68	Archibald Underpass	750	$ 23,000		$ 23,000	"Spot" repair 5 m; Pipe has shifted; Outfall is Submerged
AS 38	Vialoux Drive Cul-de-Sac	750	$ 28,000		$ 28,000	
OM 3	Empress Street 1	750	$ 24,000		$ 24,000	
RR 104	Red River Blvd.	750	$ 34,000		$ 34,000	
RR 30	Lotus lane	600	$ 10,000	$ 10,000	$ 20,000	Requires Rip Rap
SE 2	Rue Laverendrye	600	$ 9,000		$ 9,000	"Spot" repair 5 m; Pipe has shifted
RR 41	Churchill Drive Underpass	525	$ 14,000	$ 5,000	$ 19,000	Incomplete inspection too much sediment build-up. Requires Rip Rap
RR 108	Eastwood Drive	525	$ 28,000	$ 25,000	$ 53,000	Requires Rip Rap
AS 25	Shenfield Road	450	$ 28,000	$ 5,000	$ 33,000	Requires Rip Rap
AS 27	Ridgedale Cres	450	$ 12,000		$ 12,000	
BU 6	Delbrook Cres.	400	$ 11,000		$ 11,000	Pipe collapsed incomplete inspection.
RR 8	Stormont Drive	400	$ 9,000	$ 10,000	$ 19,000	Requires Rip Rap
ST 12	Amarynth Cres. 2	400	$ 13,000		$ 13,000	
ST 17	Harvest Lane	400	$ 17,000	$ 5,000	$ 22,000	Requires Rip Rap
OM 4	Veledrome 1	380	$ 8,000	$ 25,000	$ 33,000	Pipe collapsed incomplete inspection. Requires Rip Rap
RR 34	Oakcrest Place	375	$ 19,000	$ 50,000	$ 69,000	Requires Rip Rap
AS 70	Empress Street	300	$ 16,000		$ 16,000	
	Subtotal		**$ 966,000**	**$ 275,000**	**$ 1,241,000**	
	TOTAL		**$ 2,138,000**	**$ 565,000**	**$ 2,703,000**	

Table 7.3 (A) - Present Value of Pipe Repair Costs

Recurrence of Pipe Failure due to Bank Instability	PV Pipe Repair Costs for 50 Years		
	$40,000.00	**$50,000.00**	**$60,000.00**
5 years	$164,000.00	$205,000.00	$246,000.00
10 years	$93,000.00	$117,000.00	$140,000.00

Note: Assumes life expectancy of bank stability repairs is 50 years. PV rounded to nearest $1000

Table 7.3 (B) - Present Value of Pipe Repair Costs

Recurrence of Pipe Failure due to Bank Instability	PV Pipe Repair Costs for 30 Years		
	$40,000.00	**$50,000.00**	**$60,000.00**
5 years	$144,000.00	$180,000.00	$216,000.00
10 years	$85,000.00	$106,000.00	$127,000.00

Note: Assumes life expectancy of bank stability repairs is 30 years. PV rounded to nearest $1000

SECTION 8.0
Recommended
O & M

8.0 RECOMMENDED OPERATIONS AND MAINTENANCE

The following sections describe the required maintenance for those outfalls which have been impacted by bank erosion, sediment build-up within the outfall pipe and/or ice damage. Where possible maintenance is assumed to be performed by WWD personnel. Operational recommendations are also given for continued inspections of outfalls that are at risk of failure or require monitoring due to their present condition.

8.1 Outfalls Requiring Rip Rap Repairs

Inspections identified a total of 14 outfalls which were rated 5 in terms of erosion of the bank, and where neither the overall geotechnical rating nor the structural rating had yet dropped to category 5. Those outfalls are listed on Table 8.1 along with estimated costs to provide adequate erosion protection. The estimated total cost to upgrade the erosion protection is $97,500.

8.2 Outfalls Affected by Ice Damage

From the results of the outfall inspection program, 44 outfalls were identified as having been damaged by ice. Damages range from small dents in the pipes to damaged grates and severely damaged outlets. The outfalls were separated into major and minor damage categories, and are listed in Tables 8.2 and 8.3 respectively. The tables provide commentary on the extent of the damage and estimated costs of the associated repairs.

No formal priority was given to any of the particular outfalls requiring ice damage repairs. However, the 14 outfalls with major damage should be addressed prior to the remaining 24 categorized as having only minor damage. Approximately half of the outfalls with ice damage have also been assigned a failure condition rating of 5. Costs have not been assigned to repair these outfalls to eliminate duplication of expenditures. It is assumed that the capital upgrade work will include upgrading the outlet, and eliminate the need to fix any ice damage. Since the ice damage repairs and recommended capital upgrades are to be done within the same five year period, performing both tasks would effectively duplicate the cost for the repair. Phasing the repairs over time will be dependent on the rehabilitation schedule discussed in Section 9.0. It will also depend upon available WWD personnel and budget resources.

Total estimated costs associated with the repairs of the ice damage amount to $10,500.00 and $19,000.00 for the necessary major and minor repairs respectively. Each estimate was based on the repair work being performed by WWD personnel. It was assumed that three man crews, at $150.00 per crew hour, would be required to perform the repairs. The estimates took into account required materials and equipment, and a minimum for each repair was assessed at $1000.00. Details of the required repairs is presented in Appendix G.

8.3 Outfalls with Debris and Sediment Build-up

From those outfalls inspected, approximately 101 have restricted flow due to sediment or debris build-up inside the outfall pipe. For the purpose of prioritizing a list for recommended maintenance, the amount of the restriction has been placed into one of the two following categories:

- Major hydraulic restriction caused by sediment build-up of 50 percent or more of the pipe's total cross-sectional area.

- Minor hydraulic restriction caused by sediment build-up of less than 50 percent of the pipe's total cross-sectional area.

Table 8.4 lists 34 outfalls which are categorized as having major sediment build up, and Table 8.5 lists 67 outfalls categorized as having minor sediment build up. The table provides commentary on the amount of sediment build up in the pipe and an estimated cost associated with cleaning the pipe which is discussed below. As can be seen in the tables, four of the outfalls have been scheduled for service in 1998. It was requested that KGS Group forward to WWD a list of problem outfalls requiring maintenance. These outfalls were selected from the list forwarded to the WWD. upon request.

The outfalls on the list have been prioritized for maintenance purposes. The ranking is based upon several factors including:

- Amount of the sediment build up
- Risk of damage from sewer "backup" associated with the type of sewage conducted by the outfall
- Risk of damage from sewer "backup" associated with the drainage area of outfall which is correlated to the size of the outfall

The outfalls were ranked based on the amount of risk associated with creating a "backup" condition and the damages caused by the "backup". For example, a higher priority would be given to a large waste water sewer overflow with significant sediment build up, and a lower priority would be given to a smaller land drainage sewer with less sediment build up. Eight of the outfalls have been listed as severely obstructed. Three of the outfalls are currently being addressed by the department, but the remaining five should be serviced as soon as possible or determined to be redundant

The costs associated with cleaning the outfall pipes were estimated (see Table 8.4 and 8.5) based upon the following:

1. Estimated time to flush the pipe system based upon a working crew consisting of necessary flushing truck(s), vacuum truck, plus operators and labourer(s). Average cost of $300.00 per crew hour.
2. Estimated cost associated with difficult access to the site
3. Estimated cost associated with dewatering a submerged outfall

The total costs for flushing the outfalls affected by major sediment build up is estimated to be approximately $127,000.00, and the total costs associated with servicing the outfalls with minor sediment build up is estimated to be approximately $87,000.00. Those outfalls that are submerged below the water level will be particularly expensive to flush especially for the larger pipes. A premium cost has been estimated for each submerged outfall based on the requirement to dewater the pipe prior to flushing.

Although all outfalls have been assigned a cost, all are not necessarily required to be serviced immediately. The outfalls categorized as having major sediment build up should be serviced first, and staging of the remainder of the outfalls could follow according to the set priorities and/or budget resources. The phasing of the required maintenance should take into account other factors such as the outfalls overall condition rating. Should a particular outfall be restricted by sediment build up, and have an overall poor rating, a decision must be made to prioritize the maintenance or the rehabilitation of the manhole. This would eliminate duplication of resources. Further discussion on the overall phasing of the outfalls maintenance and rehabilitation is provided in Section 9.0.

8.4 Future Inspections

Continued inspection and assessment of the outfalls will ensure the performance of the outfalls over the long term. As well, It will provide the necessary information for effective maintenance programs. Future expenditures will depend upon accurately determining which outfalls require maintenance or upgrading as they deteriorate or reach their design life. An effective inspection program will take into consideration the current condition of an outfall, and when it was last inspected. The methodology for determining the requirements of future inspections, and a detailed 5 year plan is presented below. This method incorporates the developed information management system (IMS) as a tool to organize past and future inspections.

The IMS described in Section 5.0 should be used to assess which outfalls require inspection based upon their respective condition ratings and the date when they were last inspected. The following criteria is suggested for the timing of inspections based upon the condition rating:

1. Outfalls having an overall condition rating of 5 should be scheduled for repair or upgrade;
2. Outfalls with an overall condition rating of 4 should be reinspected within approximately 2 years of the date of the last inspection;
3. Outfalls with an overall condition rating of 3 should be reinspected within approximately 5 to 6 years of the date of the last inspection;

4. Outfalls with an overall condition rating of 1 or 2 should be reinspected within approximately 10 years of the date of last inspection.

The above criteria will allow for closer monitoring of those outfalls near a failure condition, but will also maintain a reasonable monitoring level on outfalls that are in good to fair condition. The criteria also provides a means for distributing the inspections over time, so that a more manageable number of inspections is performed each year. The criteria should be reviewed periodically, and time frames between inspection adjusted if necessary.

Based upon the suggested criteria and the recent inspection program, a 5 year plan for required inspections has been formulated as shown in Table 8.6. The plan also considers those outfall pipes which were unable to be inspected during this study, which include submerged outfall pipes and pipes equal to or smaller than 300 millimetres in size. The remaining inspections would be performed over two years to equally distribute the inspections over the next five years, and allow for extra time to perform inspections on submerged outfalls. A suggested listing of outfalls to inspect in the first two years is provided on Appendix I. As an estimate, the additional inspections are distributed equally among the rating classes, as it is probable that the resulting assessment could reveal any condition state for any given outfall. This is supported by the results of the outfalls assessed in this study.

The program has been established to be self sustaining. As certain outfalls will reach there design life and move to a higher priority rating (ie., their condition worsens) an equal number of outfalls will be repaired or upgraded to a satisfactory condition. Thus, a balance is achieved over time for the entire inventory of outfalls, and no additional inspections need be incorporated into the program, from year to year. The IMS tool, as developed, will aid managers in deciding which outfalls to inspect each year based upon the latest condition rating and the date of the last inspection. Using the specified criteria, a list of outfalls can be extracted from the database at the beginning of each inspection season.

It is assumed that the inspections will be performed using the methods developed during this study, and estimates of cost are provided. It is assumed that the costs will be similar for inspections performed by WWD personnel and by consultants because the same manpower and equipment are required. It is also assumed that the televised inspections would be performed by a local sewer services contractor.

The budget estimates presented in Table 8.6 do not include costs for outfalls not inspected in 1996-97 that will require special provisions for access. Provisions such as dewatering the pipe for submerged outfalls, sediment build-up removal or access to treated sewer outfalls from one of the three water pollution control centres. As listed in Table 4.2, 65 outfalls were not inspected because they were submerged, nine [9] outfalls were not inspected because there was no access to the outfall, and two [3] outfalls had severe sediment build-up problems that prevented inspection. For a listing of the outfalls which were not inspected, refer to Appendix E which describes each outfall and the reason it was not inspected.

The three outfalls with sediment build-up are scheduled for cleaning maintenance, and if successful the pipe can be inspected after the sediment is removed. Costs have been carried in the sediment build-up maintenance estimates for inspection.

No costs have been carried in the estimates for the three outfalls from the water pollution control centres. Because these outfalls are continuously discharging treated sewage to the river, the inspections would have to be coordinated with the individual centres, and may be performed at such time when the plants are down for major maintenance. The remaining six outfalls that KGS Group inspectors were locked or frozen out of should be accessible in the future without additional costs.

Future inspections for outfalls that were submerged during this study will depend on River levels and the practicality of dewatering the pipe. 40 of the 65 submerged outfalls were only partially submerged. Since the river levels were up to 2.5 feet higher than normal winter levels, it is assumed that most of the outfalls would be accessible during normal water level periods, at no additional cost. This may, however, affect the scheduling of some of the outfalls.

The final 25 outfalls that were not inspected in the 1996-97 survey were totally submerged. Ten of these outfalls were less than 1200 millimetres in diameter, and it is assumed that at normal winter water levels these outfalls would be at least partially accessible. It is recommended that an additional $2500.00 per outfall be estimated to dewater these outfalls. Typically these outfalls could be plugged at the outlet with a sewer safety/test plug, and then pumped dry. After dewatering, the outfalls could be inspected by CCTV unit. In order to justify the additional cost each outfall should be assessed independently on the basis of its current performance status and risk of failure due to the type of effluent it discharges. For this reason, no additional costs have been carried in the tables, but a contingency amount to a total $25,000.00 should be considered.

Nine of the 25 totally submerged outfalls were larger than 1200 millimetres in diameter. Although some may be partially accessible at this time, safety sewer plugs are not readily available for this pipe size. Inspections performed by divers would produce limited results, because of the opacity of the water/effluent. Costs associated with building a cofferdam in front of the outlet will vary greatly by location. A minimum 5 foot cofferdam is assumed, and will cost between $10,000.00 and $25,000.00 depending on the alternative best suited for the site. Alternative cofferdam systems include:

- Earth dam made from imported clay and fill at $10-12 per cubic metre in-place. These dams are the most common type in Winnipeg, but are labour intensive and costly.
- Sand bag dykes. Can be recovered from the river more readily, but are just as costly as earth dams.
- Rubber bladder ("Aqua dam") cofferdam, up to 9' high. These dams are portable, and cost effective, but have not been used locally.
- Modular sand dykes. These dykes are also transportable, but would require good site access for machinery. Costing data is not readily available, but is competitive with sand bag dykes, and is less manual labour intensive.

Not all alternatives will be practical for each site based upon the access to the outlet, and the bank profile and stability. From the above information, additional costs for inspecting these 9 outfalls could be as high as $150,000.00. Again, the additional cost for each outfall inspection should be assessed independently on the basis of its current performance status and risk of failure due to the type of effluent it discharges. For this reason, no additional dollar amounts have been carried in the estimate.

The last six outfalls that were totally submerged are submerged by design. They are part of the land drainage system, and drain into retention ponds that are part of the Bunn's Creek drainage area. The need for inspecting these pipes will be dependent on the risk of failure of these outfalls. An assessment of the pipes current performance would be indicative of the outfalls condition. Also, all six of these outfalls have been assessed with a geotechnical and stream rating of 1, which give no cause for concern associated with these aspects of the overall condition of the pipe. At this time, it is recommended that these pipes not be inspected structurally (internally) within the five year plan, but a geotechnical rating of the bank stability should be considered within five years. No additional cost has been carried for these outfalls.

TABLES

Table 8.1: Cost Estimate for Outfalls Requiring Erosion Protection Maintenance

Outfall ID	Name	Type	Size	Geotech CR	Struct CR	Cost Estimate [1] Erosion Protection
RR-19	Banning Rd.	LDS	1370	1	1	10,000.00
RR-2	Lemay Ave.	LDS	900	2	1	10,000.00
RR-21	Bishop Grandin Blvd. 2	LDS	750	1	2	10,000.00
RR-22	Plaza Dr.	LDS	2400	1	2	10,000.00
RR-82	Bredin Dr.	LDS	450	5	4	10,000.00
ST-22	Crestview Park Dr.	LDS	762	2	1	5,000.00
ST-3	Booth Dr.	LDS	1850	4	5	5,000.00
ST-4	Sturgeon Rd. (north)	LDS	1500	4		12,500.00
ST-7	Greenway Cres.	LDS	600	3	3	5,000.00
ST-7.1	Greenway Cres. 2	LDS	750	3		5,000.00
ST-8	Lonsdale Dr.	LDS	600	1	3	5,000.00
BU-1	Henderson Hwy.	LDS	1375	1	1	2,500.00
BU-13	Raleigh St. 1	LDS	400	3	3	2,500.00
BU-2	Henderson Hwy. 2	LDS	1200	4	1	5,000.00
	Total					**97,500.00**

Note: [1] Based on \$500 per lineal meter of rip rap or \$25/m^3 and reasonable site access.

Table 8.2 Outfalls with Major Ice Damage at Outlet

Outfall ID No.	*Name*	*Size*	*Comments*	*Overall CR*	*Repair Cost*
AS-10	Pender St.	900	Outlet bent, opening reduced by 50 %.	5	$1,000.00
AS-13	Willow Ridge Rd.	1800	Outlet bent inwards and torn. Outfall extends from bank and could be trimmed back.	3	$1,000.00
AS-18	McCallum Cres.	1350	CMP bent closed at outlet. Opening reduced by 70%. Outfall extends from bank and could be trimmed back.	5	N/A[1]
AS-42	Conway CS	2500	Ice damage upstream side of outlet, top of CMP bent.	5	N/A[1]
AS-61	Doncaster St.	2250	CMP bent at outlet. Outfall extends from bank and could be trimmed back.	5	N/A[1]
AS-67	Wellington Cres. at CNR Bridge	450	Top of outlet is bent. Outfall extends from bank and could be trimmed back.	3	$1,000.00
AS-78	Elm St.	750	CMP bent at outlet, opening reduced by 25 %.	4	$1,000.00
AS-88	Cornish St. 2	1500	Grate is bent and twisted.	4	$4,000.00
RR-100	Whellams Lane	1200	Top of outfall flattened at end.	5	N/A[1]
RR-59	Rue La Verendrye	1200	Upstream side of outlet pushed in.	5	N/A[1]
RR-60	Rue La Verendrye FPS	600	Appears to be bent out of alignment in downstream direction.	5	N/A[1]
RR-79	Hart Ave.	2850x2130	Outlet bent and torn open.	5	N/A[1]
RR-87	Chelsea Pl	2275	First 1 m of pipe from outlet open and displaced from 3 to 9 o'clock due to ice damage.	4	$1,500.00
ST-16	Valleyview Dr. 2	1050	Top of outlet bent, grating damaged and hanging open.	4	$1,000.00
				TOTAL	**$10,500.00**

Notes: 1. Outfall is scheduled for capital upgrading which will account for costs of ice damage repairs.

Table 8.3 Outfalls with Minor Ice Damage at Outlet

Outfall ID No.	*Name*	*Size*	*Comments*	*Overall CR*	*Repair Cost*
AS-15	Paradise Bay	600	Outlet was slightly bent at top and side of pipe. Outfall extends from bank and could be trimmed back.	3	$1,000.00
AS-16.5	Orchard Park	600	Outlet is slightly bent. Outfall extends from bank and could be trimmed back.	3	$1,000.00
AS-19	Carroll Rd.	1800	Minor ice damage to outlet.	5	N/A[1]
AS-24	Fairmont	2500	Small piece of CMP was missing at outlet.	2	$6,000.00
AS-60	Chataway Blvd.	900	Outlet missing 250 mm piece between 3 and 5 o'clock.	4	$1,500.00
AS-63	Riverbend Cres.	2250	Upstream side of outlet bent.	4	$1,000.00
AS-67A	Route 90 Bridge	450	Top of pipe was bent. Opening reduced 10 - 20 %.	4	$1,000.00
AS-69	Tylehurst St.	2250	Ice damage to protective railing around outlet structure.	2	$1,000.00
AS-76	Ash St FPS	2100	Upstream portion of pipe is bent.	1	$1,000.00
BU-2	Henderson Hwy. 2	1200	Outlet slightly bent.	5	N/A[1]
BU-6.1	Delbrook Cres. 2	600	Top of outlet bent.	4	$1,000.00
FL-2	Kildare at Floodway	3000	Guard rail around outlet bent.	5	N/A[1]
LS-2	Rue Des Trappistes	450	Slight damage to top of pipe.	2	N/A[1]
OM-2	Clifton St. Overflow	2700	Chainlink fence on wingwall damaged.	2	$1,500.00
RR-10	Radcliffe 1	1200	Minor denting from 9:00 to 11:00	4	N/A[2]
RR-2	Lemay Ave.	900	Outlet dented from 6:00 to 2:00.	5	N/A[1]
RR-35	Wildwood Golf Course	900	Small dent at top of outlet.	3	N/A[2]
RR-38	Cockburn St. FPS	1500	Outlet slightly bent.	1	$1,000.00
RR-41	Churchill Dr. Underpass	800	Small dents at outlet from 9:00 to 12:00.	5	N/A[2]
RR-62	McDermot Ave.	2700	Tapered end of CMP slightly bent on upstream side.	4	$1,000.00
RR-90	Linden Ave.	1800	Concrete at outlet in poor condition.	5	N/A[1]
SE-37	Fermor Ave.	600	Outlet slightly bent.	4	$1,000.00
ST-1	Old Mill Rd.	400	40 mm dent at 9:00 upstream side.	3	N/A[2]
ST-22	Crestview Park Dr.	750	Small dents at 12:00 and 3:00.	5	N/A[2]
				TOTAL	**$19,000.00**

Notes: 1. Outfall is scheduled for capital upgrading which will account for costs of ice damage repairs.
2. Insignificant damage. Repair not necessary at this time. Monitor for increased damge in future.

Table 8.4 Major Sediment Build-up in Outfalls

Outfall Name	*Outfall ID No.*	*Sewer Type*	*Size (mm)*	*Description of Sediment Build up*	*Condition Rating*	*Submerged*	*Difficult Access*	*Cost*
Lombard Ave.	RR-61	CSO	900	100% of Pipe Area	3		✓	$12,000
Water Ave.	RR-56	CSO	457	100% of Pipe Area	3			$2,000
Rue Plinguet	SE-11	CSO	300	100% of Pipe Area	3			$1,200
Niakwa Rd. 2	SE-38.1	LDS	450	100% of Pipe Area	1			N/A[1]
Elmwood Park	RR-81	LDS	900	95% of Pipe Area	4		✓	$2,800
Lotus Lane	RR-30	LDS	600	95% of Pipe Area	5		✓	$2,800
Setter St.	ST-6	LDS	600	Severe sediment and debris build up from 2.1m to 31.5m.	2			$1,500
Wellington Cres.	AS-64	LDS	300	Severe.	4		✓	$2,200
Whellams Lane	RR-100	WWSO	1200	75% of Pipe Area	5			$2,400
Grandmont Blvd.	RR-6	WWSO	750	70% of Pipe Area	4			$1,800
Cote St.	SE-28	WWSO	450	75% of Pipe Area	4		✓	$2,200
Burrows Ave.	RR-76	CSO	2400	70% of Pipe Area	3			$4,000
Eccles St.	RR-47	CSO	750	80% of Pipe Area	3	✓		$7,800
Douglas Park Rd.	AS-57	CSO	300	75% of Pipe Area	2		✓	$2,200
Rossmere Cres.	RR-93	LDS	2900	70% of Pipe Area	3	✓		$13,500
St. Vital Bridge	RR-39.7	LDS	1600	80% of Pipe Area	2	✓	✓	$11,900
The Forks E. of CNR	AS-97	LDS	1200	75% of Pipe Area	2			$2,500
Eccles St. 2	RR-47.1	LDS	1200	70% of Pipe Area	2			$2,400
Vialoux Dr. Cul-de-Sac	AS-38	LDS	750	Major build up 13.5 m to 18 m. Minor build up 23 m to 33 m and 59.5 m to 64.2 m.	5		✓	$3,000
Rue St. Pierre	LS-1	LDS	300	75% of Pipe Area	4		✓	$3,000
Radcliffe	RR-11	WWSO	760	50% of Pipe Area	4		✓	$2,500
Alcott	ST-13	WWSO	600	50% of Pipe Area	3			N/A[1]
Crane Ave. Outfall	RR-27	CSO	900	50% of Pipe Area	4			$1,800
Fermor Ave	RR-32.5	LDS	1950	50% of Pipe Area	3	✓	✓	$13,400
Summerview Lane	RR-106	LDS	1800	50% of Pipe Area	3	✓	✓	$11,900
Churchill High School	RR-47.5	LDS	1600	50% of Pipe Area	2	✓		$9,300
Raleigh St. 3	BU-15	LDS	750	50% of Pipe Area	3			$1,500
Bonner Ave.	BU-3	LDS	525	50% of Pipe Area	2			$1,200
Rue Bourgeault	SE-10	LDS	450	50% of Pipe Area	4			$1,200
Amarynth Cres. 2	ST-12	LDS	400	50% of Pipe Area	5			N/A[2]
Ridgedale S.P.S.	AS-26	WWSO	250	Infilled at outlet.	5			N/A[2]
Chataway Blvd.	AS-60	CSO	900	Infilled from 8 to 11.5 m and 14.6 to 16.9 m.	4			$1,800
Hargrave St.	AS-93	CSO	700	Infilled causing water backup at 10.6 m.	5			N/A[2]
Empress Street 2	AS-71	LDS	300	Infilled at 58.6 m.	3			$1,200
							Total	**$127,000**

Notes: 1. Outfall scheduled to be cleaned in 1998
2. Outfall is scheduled for capital upgrading which will account for costs associated with sediment buildup

Table 8.5 Minor Sediment Build-up in Outfalls

Outfall Name	Outfall ID No.	Sewer Type	Size (mm)	Description of Sediment Build up	Condition Rating	Submerged	Difficult Acess	Cost
Valleyview Dr. 1	ST-15	WWSO	600	35% of Pipe Area	4			$1,800
Selkirk Ave.	RR-74	CSO	1800	35% of Pipe Area	3			$1,200
Killarney St.	RR-43	LDS	1200	40% of Pipe Area	2			$1,200
Larchdale Cres. SPS	RR-96	LDS	1050	40% of Pipe Area	5			N/A[2]
Churchill Dr. Underpass	RR-41	LDS	800	35% of Pipe Area	5			N/A[2]
Silver Ave.	ST-19	WWSO	525	Moderate sediment build up from 0m to 5m and from 73m to 80m.	4			$1,200
McDermot Ave.	RR-62	CSO	2700	25% of Pipe Area	4			$2,000
Riverbend Cres.	AS-63	CSO	2300	Sediment is considerable towards end of pipe.	4			$1,800
Colony St.	AS-90	CSO	1800	25% of Pipe Area	5			N/A[2]
Wildwood Golf Coarse	RR-35	CSO	900	Moderate throughout enitre length.	3			$1,500
Crane Ave.	RR-26	CSO	600	Moderate sediment build up in pipe from 55 m to 89 m.	4			$1,200
Pritchard Ave.	RR-75	CSO	250	25% of Pipe Area	4			$1,200
Chelsea Pl	RR-87	LDS	2260	Measurement L3 to water in pipe. Moderate	4			$1,800
John Black Ave.	RR-101	LDS	1800	30% of Pipe Area	2			$1,800
Valleyview Dr. 2	ST-16	LDS	1050	Some moderate sediment build up in concrete portion of pipe and at pipe outlet.	4			$1,200
La Maire Ave.	LS-4	LDS	1000	25% of Pipe Area	2			$1,200
Bishop Grandin Blvd. 2	RR-21	LDS	750	Moderate build up from 54 m to outlet.	5			N/A[2]
Victoria Cres. 2	RR-29	LDS	750	30% of Pipe Area	4	✓	✓	$6,800
Kingston Row Underpass	RR-40	LDS	750	30% of Pipe Area	4			$1,200
Riverdale Ave.	RR-34.8	LDS	600	25% of Pipe Area	3			$1,200
Delbrook Cres.	BU-6	LDS	400	25% of Pipe Area	5			N/A[2]
Metcalfe Pl.	RR-46	CSO	2000	15% of Pipe Area	4			$1,800
Newton Ave.	RR-94	CSO	1850	20% of Pipe Area	2			$1,800
Baltimore St. FPS	RR-45	CSO	1800	20% of Pipe Area	4			$1,800
Linden Ave.	RR-90	CSO	1800	Up to 300 mm of sediment build up.	5			N/A[2]
Arbuthnot	AS-87	CSO	1400	15% of Pipe Area	3			$1,500
Park Bvld.	AS-58	LDS	2400	Some sediment at 13m from outlet.	3			$1,800
Renfrew St.	AS-72	LDS	2400	20% of Pipe Area	2	✓		$10,500
Dunham Rd. Outfall	RR-33	LDS	1200	20% of Pipe Area	3	✓		$6,500
St. Charles St. 2	AS-9	LDS	900	Some debris in line from 27.2 m to 41.9 m and 49.3 m to 53.7 m.	3			$1,200
Dowker Ave. Outfall	RR-28	LDS	900	15% of Pipe Area	5			N/A[2]
Guay Ave.	SE-30	LDS	750	Some debris in pipe and debris build up on	4			$1,200
Fermor Ave.	SE-37	LDS	600	Some debris build up in pipe.	4			$1,200
							Subtotal	**$57,600**

Notes: 1. Outfall scheduled to be cleaned in 1998
2. Outfall is scheduled for capital upgrading which will account for costs associated with sediment buildup

Table 8.5 Minor Sediment Build-up in Outfalls (continued)

Outfall Name	*Outfall ID No.*	*Sewer Type*	*Size (mm)*	*Description of Sediment Build up*	*Condition Rating*	*Submerged*	*Difficult Acess*	*Cost*
Lonsdale Dr.	ST-8	LDS	600	Some sediment build up in concrete pipe.	5			N/A[2]
Bredin Dr.	RR-82	LDS	450	20% of Pipe Area	5			N/A[2]
Harvest Lane	ST-17	LDS	400	Some sediment build up from 16.6m to 18m.	5			N/A[2]
Hart Ave.	RR-79	CSO	2850	Minor sediment build up in pipe	5			N/A[2]
Clifton St. FPD	AS-74	CSO	2100	Sediment build up at outlet.	5			N/A[2]
Donald St.	AS-94	CSO	1900	10% of Pipe Area	3			$1,800
Rue Despins	RR-54	CSO	1400	10% of Pipe Area	5			N/A[2]
Rue La Verendrye	RR-59	CSO	1200	Minor sediment build up in pipe.	5			N/A[2]
Strathmillan Rd.	AS-37	CSO	900	Minor vegetation and sedimentation	5	✓		N/A[2]
Maryland St.	AS-86B	CSO	600	Minor sediment build up in pipe	3	✓		$5,200
Rue La Verendrye FPS	RR-60	CSO	600	Minor sediment from 3 m to 6.5 m. Moderate debris in pipe from 20.5 m to 34 m.	5			N/A[2]
Booth Dr.	ST-3	LDS	1850	Minor sediment build up in pipe	5			N/A[2]
Crestview Park Dr.	ST-21	LDS	1676	Minor sediment built up	4			$1,500
Hamilton Ave.	ST-18	LDS	1500	Minor sediment build up in pipe	4			$1,500
Radcliffe 1	RR-10	LDS	1200	10% of Pipe Area	4			$1,500
Southbridge Dr.	SE-43	LDS	900	Some minor sediment build up in conc. portion of pipe.	1		✓	$2,200
Archibald Underpass	RR-68	LDS	750	Debris in pipe at 4.6 m	5	✓		N/A[2]
Niakwa Rd. 1	SE-38	LDS	450	Minor sediment and debris build up in pipe.	1			$1,200
Ash St FPS	AS-76	CSO	2100	> 5% of Pipe Area	1			$1,800
Rue Dumoulin 3	RR-58	CSO	1060	> 5% of Pipe Area	5			N/A[2]
Plaza Dr.	RR-22	LDS	2400	> 5% of Pipe Area	5			N/A[2]
Glasgow Ave.	RR-48	LDS	1200	5% of Pipe Area	4			$1,500
Ruby St. 1	AS-81	CSO	2100	Sediment build up from outlet to 10 m in pipe.	5			N/A[2]
Polson Ave. FPS	RR-83	CSO	1800	Measurement L3 affected by ice in pipe.	3			N/A[1]
Linden Ave. - Flood	RR-91	CSO	1675	Sediment and debris build up in pipe.	3			$1,500
Kennedy St.	AS-91	CSO	760	From 85m to 92 m.	5			N/A[2]
Park Dr.	RR-50.5	LDS	1200	Sediment and debris build up throughout length of pipe.	3			N/A[1]
River Pointe Pl.	RR-18	LDS	1050	Stone in end of outfall	4			$1,200
Lanoo Dr.	AS-21.5	LDS	900	Sediment and debris from 7.4 m to 31.1 m.	3	✓	✓	$7,500
Wellington Cres. 2	AS-66.8	LDS	450	Debris in pipe 1.5 m to 3.8 m.	2			$1,200
Empress Street	AS-70	LDS	300	Sediment build up at outlet.	5			N/A[2]
							Subtotal	**$29,600**
							Total (rounded to nearest $1000)	**$87,000**

Notes: 1. Outfall scheduled to be cleaned in 1998
2. Outfall is scheduled for capital upgrading which will account for costs associated with sediment buildup

Table 8.6
Five Year Plan for Future Inspections

Description	Number of Inspections Required		Estimated Cost
	Televised	"Walk-Through"	
<u>Year 1</u> (1999)			
Overall Condition Rating of 4 from 96-97	31	21	$28,000
Not Inspected 96-97(approx. ½)[1]	17	21	$23,000
Outfall not inspected < 300 mm dia. (approx. ½)	28	0	$10,000
Subtotal	76	42	$61,000
<u>Year 2</u> (2000)			
Not Inspected 96-97(approx. ½)[1]	17	22	$24,000
Outfall not inspected < 300 mm dia. (approx. ½)	28	0	$10,000
Subtotal	45	22	$34,000
<u>Year 3</u> (2001)			
Overall Condition Rating of 4, Last inspection dated earlier than Year 1[2]	40	25	$30,000
Subtotal	40	25	$30,000
<u>Year 4</u> (2002)			
Overall Condition Rating of 4, Last inspection dated earlier than Year 2[2]	9	4	$7,000
Subtotal	9	4	$7,000
<u>Year 5</u> (2003)			
Overall Condition Rating of 3 from 96-97	16	17	$19,000
Overall Condition Rating of 4, Last inspection dated earlier than Year 3[2]	35	22	$30,000
Subtotal	51	39	$49,000
Total[3]			**$181,000**

Notes:
1. Estimate does not include costs to dewater those outfalls which are submerged
2. Estimate only based upon previous number of outfalls with an overall rating of 4 or 3, and a 20% chance that outfalls not inspected would be rated 4 or 3
3. Rounded to the nearest $1000

SECTION 9.0
Phasing of Capital
and O & M

9.0 PHASING OF CAPITAL UPGRADES AND MAINTENANCE

The Water and Waste Department (WWD) requested that the recommended capital upgrades and maintenance costs be distributed over a 5 year period for budgeting purposes. The following sections describe the recommended phased approach to the capital and maintenance expenditures. The recommendations are based upon the assigned priority for upgrades and maintenance categories.

9.1 Capital Upgrades 5 Year Plan

Based upon the estimated costs and priority ranking assigned to those outfalls that require capital upgrade repairs (see Sections 7.1 and 7.2), a phased approach for completing the work is recommended. The WWD has budgeted approximately $552,000.00 per year for the next 5 years for capital upgrades. Table 9.1 lists outfalls to be upgraded for each year, and their estimated total cost of repair. The costs shown include allowances for engineering, WWD overhead and contingencies. The cost estimates are, however, shown in constant 1998 dollars, and do not account for inflation. A current rates of inflation the contingencies carried in the estimate should be sufficient to cover extra costs due to anticipated inflation.

As can be seen in Table 9.1, the list closely follows the rankings discussed for priority of repair. To stay within budgetary constraints minor changes to the ranking order were necessary.

Due to the total amount of the estimated capital upgrade costs, it will be difficult to repair any additional outfalls than those specified in the 5 year plan. The existing $552,000.00 per year budget does not allow for the incorporation of more outfall repairs that may be required as additional outfall pipes reach a failed state.

9.2 Operations and Maintenance 5 Year Plan

As discussed in Chapter 8, the suggested operations and maintenance (O&M) program consists of rip rap repairs, ice damage repairs, sediment build-up maintenance and a continued inspection program. Table 9.2 summarizes the recommended O&M 5 year plan. The estimated expenditures are distributed relatively equal over the period. Initially, higher costs will be incurred for major maintenance items that require attention over the short term. All estimates shown are presented in constant 1998 dollars.

The percentages shown for the Item description represent the portion of the overall required maintenance for the category. The maintenance should be performed in the priority order set for each category, as discussed in Chapter 8. Additional allowances have been made for ice damage repairs and sediment build-up maintenance as part of an overall O&M program. It is recommended that the WWD carry approximately $100,000.00 per year in the O&M budget to accommodate routine maintenance and inspection operations.

Figure 1, illustrates the total recommended budget plan for the next 5 years. It includes a bar chart for both required capital upgrades and O&M expenditures.

TABLES

Table 9.1
Recommended 5 Year Outfall Capital Upgrades Plan

Outfall ID#	NAME	Stream	Pipe size (mm)	Total Estimated Cost For Pipe Repairs	Total Estimated Cost For Erosion Protection	Total Estimated Cost	Year of Repair
AS 74	Clifton Street FPD	Assiniboine	2100	$ 62,000	$ 10,000	$ 72,000	1
RR 60	Rue La Verendrye	Red	600	$ 10,000	$ 25,000	$ 35,000	1
RR 100	Whellams Lane	Red	1200	$ 10,000	$ 10,000	$ 20,000	1
AS 23	Dieppe Road	Assiniboine	650	$ 7,000	$ 5,000	$ 12,000	1
RR 3	St. Norbert X-Kalay Lift Station Overflow	Red	300	$ 15,000	$ 10,000	$ 25,000	1
AS 9.9	Sheir Dr.	Assiniboine	250	$ 7,000		$ 7,000	1
AS 26	Ridgedale S.P.S.	Assiniboine	250	$ 11,000		$ 11,000	1
RR 79	Hart Ave	Red	2850	$ 78,000	$ 25,000	$ 103,000	1
AS 61	Doncastor Street	Assiniboine	2250	$ 145,000	$ 25,000	$ 170,000	1
AS 81	Ruby St. #1	Assiniboine	2100	$ 51,000	$ 10,000	$ 61,000	1
RR 90	Linden Ave.	Red	1800	$ 30,000	$ 5,000	$ 35,000	1
	Subtotal			**$ 426,000**	**$ 125,000**	**$ 551,000**	
RR 51	Marion Street FPD[1]	Red	1600	$ 47,000	$ 10,000	$ 57,000	2
AS 42	Conway CS	Assiniboine	2500	$ 282,000	$ 50,000	$ 332,000	2
RR 52	Marion Street[1]	Red	1800	$ 60,000	$ 10,000	$ 70,000	2
AS 90	Colony Street	Assiniboine	1800	$ 76,000	$ 25,000	$ 101,000	2
	Subtotal			**$ 465,000**	**$ 95,000**	**$ 560,000**	
AS 8	St. Charles Street #1	Assiniboine	250	$ 8,000		$ 8,000	3
RR 55	Rue Despins FPD[1]	Red	1200	$ 37,000	$ 10,000	$ 47,000	3
RR 96	Larchdale Cres. SPS	Red	1050	$ 19,000	$ 10,000	$ 29,000	3
AS 37	Strathmillan Road	Assiniboine	900	$ 23,000	$ 25,000	$ 48,000	3
AS 91	Kennedy Street	Assiniboine	760	$ 36,000		$ 36,000	3
AS 93	Hargrave Street	Assiniboine	700	$ 24,000		$ 24,000	3
AS 29	Woodhaven Blvd.	Assiniboine	450	$ 38,000	$ 5,000	$ 43,000	3
RR 37	Calrossie Blvd	Red	450	$ 14,000	$ 10,000	$ 24,000	3
AS 83	Arlington Street 1	Assiniboine	375	$ 12,000		$ 12,000	3
ST 3	Booth Drive	Sturgeon	1850	$ 28,000	$ 5,000	$ 33,000	3
AS 16.1	Raquette street 2	Assiniboine	1800	$ 51,000	$ 5,000	$ 56,000	3
AS 19	Carroll Road	Assiniboine	1800	$ 105,000	$ 30,000	$ 135,000	3
FL 1	Deacon Reservoir	Floodway	1500	$ 29,000		$ 29,000	3
AS 18	McCallum Cres.	Assiniboine	1350	$ 12,000		$ 12,000	3
AS 10	Pender Street	Assiniboine	900	$ 12,000		$ 12,000	3
	Subtotal			**$ 448,000**	**$ 100,000**	**$ 548,000**	
RR 54	Rue Despins[1]	Red	1400	$ 41,000	$ 5,000	$ 46,000	4
FL 2	Kildare at Floodway	Floodway	3000	$ 257,000	$ 25,000	$ 282,000	4
RR 7	Cloutier Drive (Segment 1 & 2)	Red	1800/900	$ 48,000	$ 10,000	$ 58,000	4
RR 103	Valhalla Drive	Red	1675	$ 50,000	$ 10,000	$ 60,000	4
RR 31	Dunkirk Drive	Red	1400	$ 23,000	$ 20,000	$ 43,000	4
RR 28	Dowker Ave. Outfall	Red	900	$ 13,000	$ 10,000	$ 23,000	4
RR 68	Archibald Underpass	Red	750	$ 23,000		$ 23,000	4
	Subtotal			**$ 455,000**	**$ 80,000**	**$ 535,000**	
RR 58	Rue Doumoulin[1]	Red	1060	$ 29,000	$ 5,000	$ 34,000	5
RR 59	Rue La Verendrye	Red	1200	$ 35,000	$ 25,000	$ 60,000	5
AS 38	Vialoux Drive Cul-de-Sac	Assiniboine	750	$ 28,000		$ 28,000	5
OM 3	Empress Street 1	Omands	750	$ 24,000		$ 24,000	5
RR 104	Red River Blvd.	Red	750	$ 34,000		$ 34,000	5
RR 30	Lotus lane	Red	600	$ 10,000	$ 10,000	$ 20,000	5
SE 2	Rue Laverendrye	Seine	600	$ 9,000		$ 9,000	5
RR 41	Churchill Drive Underpass	Red	525	$ 14,000	$ 5,000	$ 19,000	5
RR 108	Eastwood Drive	Red	525	$ 28,000	$ 25,000	$ 53,000	5
AS 25	Shenfield Road	Assiniboine	450	$ 28,000	$ 5,000	$ 33,000	5
AS 27	Ridgedale Cres	Assiniboine	450	$ 12,000		$ 12,000	5
BU 6	Delbrook Cres.	Bunn's	400	$ 11,000		$ 11,000	5
RR 8	Stormont Drive	Red	400	$ 9,000	$ 10,000	$ 19,000	5
ST 12	Amarynth Cres. 2	Sturgeon	400	$ 13,000		$ 13,000	5
ST 17	Harvest Lane	Sturgeon	400	$ 17,000	$ 5,000	$ 22,000	5
OM 4	Veledrome 1	Omands	380	$ 8,000	$ 25,000	$ 33,000	5
RR 34	Oakcrest Place	Red	375	$ 19,000	$ 50,000	$ 69,000	5
AS 70	Empress Street	Assiniboine	300	$ 16,000		$ 16,000	5
	Subtotal			**$ 344,000**	**$ 165,000**	**$ 509,000**	
	TOTAL			**$ 2,138,000**	**$ 565,000**	**$ 2,703,000**	

Note: 1. Prices Subject to results of Combined Sewer Relief Study or Provencher Bridge Replacement

Table 9.2
Recommended Operations and Maintenance 5 Year Plan

Item Description	Estimated Cost
Year 1	
Rip Rap Maintenance[1]	$19,500
Major Ice Damage Repairs	$10,500
Major Sediment Build-up Maintenance[2]	$63,500
Outfall Inspections	$61,000
Subtotal	**$154,500**
Year 2	
Rip Rap Maintenance[1]	$19,500
Minor Ice Damage Repairs	$19,000
Major Sediment Build-up Maintenance[2]	$63,500
Outfall Inspections	$34,000
Subtotal	**$136,000**
Year 3	
Rip Rap Maintenance[1]	$19,500
Ice Damage Repairs (allowance)	$5,000
Minor Sediment Build-up Maintenance[3]	$43,500
Outfall Inspections	$30,000
Subtotal	**$98,000**
Year 4	
Rip Rap Maintenance[1]	$19,500
Ice Damage Repairs (allowance)	$5,000
Minor Sediment Build-up Maintenance[3]	$43,500
Outfall Inspections	$7,000
Subtotal	**$75,000**
Year 5	
Rip Rap Maintenance[1]	$19,500
Ice Damage Repairs (allowance)	$5,000
Sediment Build-up Maintenance (allowance)	$25,000
Outfall Inspections	$49,000
Subtotal	**$98,500**
Total	***$562,000***

Notes: 1. Amount shown is 20% of total estimated costs for rip rap repairs
2. Amount shown is 50% of estimated major sediment build-up maintenance
3. Amount shown is 50% of estimated minor sediment build-up maintenance

FIGURES

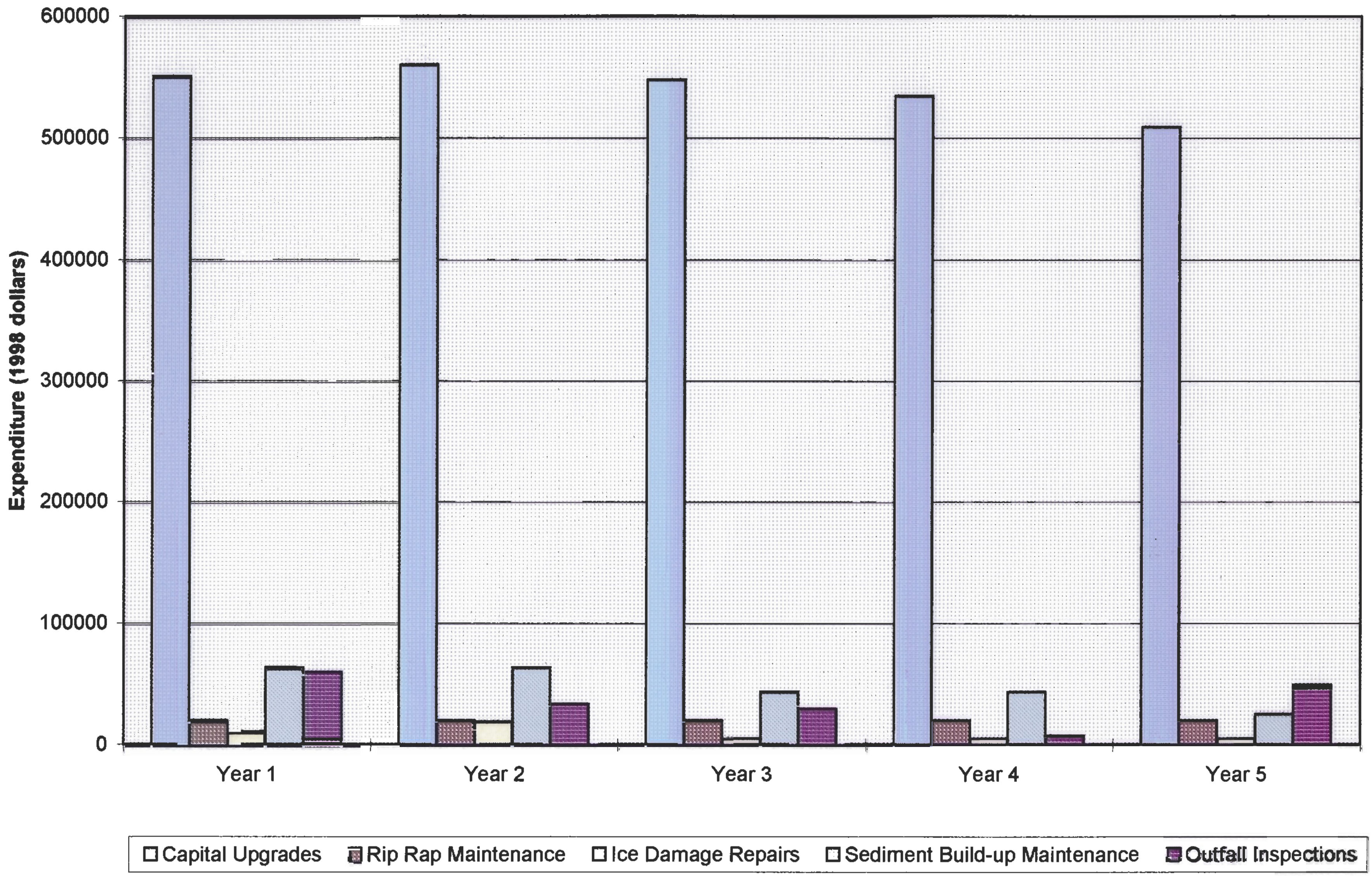


Figure 1
Recommended Outfall Budget
5 Year Plan

SECTION 10.0
Conclusions

10.0 CONCLUSIONS

Based upon the results of the study, the following conclusions are presented.

10.1 Inventory Review

1. An inventory review found 387 outfalls exist and are active on the rivers and streams within the City of Winnipeg boundary. The Water and Waste Department has jurisdiction over 349 outfalls, and 37 are under the responsibility of other civic departments, or the private sector.

2. The updated inventory listing did not include 12 outfalls identified in previous studies because they were not located or have since been abandoned.

3. During the inventory review it was noted that the City's Land Based Information System (LBIS) was missing or incorrectly identified several outfalls. KGS Group had proposed updating the LBIS database, which was subsequently authorized by the Steering Committee. A detailed list of discrepancies was forwarded separately from this report.

10.2 Inspection Program

1. An inspection methodology and rating system were developed for the condition assessment of the outfalls. The overall condition assessment was based upon the structural, geotechnical and stream condition at the location. A 5 point rating system was developed based upon a rating of 1 representing a fully satisfactory condition, and 5 represents a failed condition.

2. The inspections were phased over two "low water" seasons due to above normal river levels, and record snow accumulations.

3. KGS Group was directed to inspect only those outfalls which were under the jurisdiction of the Water and Waste Department, and further direction was given to focus on outfalls that were greater than 300 millimetres in diameter.

4. Of the 259 outfalls that were to be inspected, 71 percent were completed. The remaining outfalls were unable to be inspected due to submergence or a lack of access. Submergence of the outfalls was due primarily to high river levels.

10.3 Information Management System

1. All inventory and inspection information was entered into an Information Management System (IMS). The database was developed with a full featured user interface that allowed for Data Entry, Data Update, Database Searching and Database Reporting.

2. All 387 outfalls identified during the inventory review process were entered into the database regardless of their individual inspection status. Information on outfalls not inspected to date can be updated on the IMS once inspections have been completed.

10.4 Condition Assessment

1. The condition assessment program concluded that a total of 71 outfalls have reached a failed state. Categorically, 47 outfalls have failed structurally, 2 outfalls have failed due to unstable river banks, and 13 outfalls have failed due to stream erosion (hydraulics) problems. The remaining 8 outfalls have reached a failed condition in two or more of the rating categories.

2. It was determined that approximately 66 percent of the failed outfalls were part of the land drainage system.

10.5 Capital and Maintenance Upgrades

1. Of the recommended capital upgrades the majority of the rehabilitation require that the outfall be replaced throughout its entire length. A smaller number, 8, of the outfalls require only "spot" repairs at specific sections of the outfall where the failure is localized. In addition, one outfall was noted as having significant joint displacement, and this outfall could be repair internally by grouting the displaced joints over the length of the pipe.

2. The O&M costs for future inspections do not account for costs associated with dewatering outfall pipes prior to the inspection. It is anticipated that at normal winter water levels most outfalls will be accessible, at little or no additional cost. Where substantial costs can be incurred for cofferdams, it is recommended that each outfall be assessed for its overall performance, consequence of failure, and cost for access before proceeding with planning an internal inspection. Bank stability and stream conditions should be monitored accordingly.

3. The IMS tool developed can will managers in deciding which outfalls to inspect each year based upon the latest condition rating and the date of the last inspection. Guidelines for scheduling inspections have been developed on this basis.

10.6 Recommended 5 Year Plan

.1 A yearly budget of $552,000.00 over the next five years has been assigned by the WWD for capital upgrade costs to sewer outfalls. Based upon the results of the Outfall Condition and Maintenance Study this amount appears to be adequate at this time.

SECTION 11.0
Recommendations

11.0 RECOMMENDATIONS

Based upon the results of the study, the following recommendations are presented.

11.1 Information Management System

1. As directed by the WWD, the developed IMS does not have any programmed security functions. It was deemed unnecessary at this time, and the Water and Waste Department could program the security features at a later date. KGS Group recommended that this course of action take place because the WWD custodian of the database can customize the system according to the needs of the department.

11.2 Condition Assessment

1. KGS group inspected and assessed 9 outfalls which were smaller than 300 millimetres in diameter. Of these, 6 were deemed to be in a failed state. Such a high percentage warrants an inspection program for these outfalls.

11.3 Capital and Maintenance Upgrades

1. It was recommended that the WWD include a contingency amount of $25,000.00 in the future inspections budget to account for dewatering of totally submerged outfalls which can be inspected with a CCTV camera.

2. Total recommended capital upgrade costs are estimated to be $2,703,000.00, which includes an estimated $2,138,000.00 for required outfall pipe rehabilitation, and $565,000.00 for required erosion protection upgrades, which consist primarily of rip rap rehabilitation. The total estimate includes engineering fees, contingencies and an overhead allowance.

3. Operations and maintenance (O&M) costs are estimated to be $522,000.00. This amount includes estimates for the required rip rap ($97,500.00) and ice damage ($29,500.00) repairs, sediment build-up maintenance ($214,000.00), and the recommended continued inspection program ($181,000.00), which includes outfalls not inspected during this study.

4. A methodology was developed for evaluating outfall rehabilitation alternatives on unstable banks. Outfall SE-27 (Evans) and SE-39 (Morrow) are two outfalls that were found to be located on unstable banks. It was concluded that it would be more cost effective to make repairs to the outfall pipe at the anticipated frequency over the life expectancy of the

stabilization works than it would be to perform the bank stabilization measures at these two locations. It is recommended, however, that the Water and Waste Department pursue a cost shared arrangement with both public and private stakeholders at each location to re-evaluate the bank stabilization work. A cost sharing scheme would have to be devised separately for each location based upon many factors such as adjacent land use and ownership.

11.4 Recommended 5 Year Plan

1. A 5 year plan for the recommended capital upgrades is based upon an annual budget of $552,000.00. Yearly recommended upgrades were based upon criteria developed for the consequence of a complete pipe failure. It is recommended that the flood pump station outfalls be rehabilitated first. Followed by waste water sewer overflows, combined sewer overflows, and land drainage sewers respectively. Drainage areas and pipe size were also used as ranking criteria.

2. A 5 year plan for O&M was established. Estimated O&M costs resulting from this study were evenly spread out over the next five years, and it is recommended that the water and waste department maintain a funding level of $100,000.00 per year for future maintenance requirements.

APPENDIX A
River & Stream
Outfall Drawings

APPENDIX A

RIVER AND STREAM OUTFALL INVENTORY DRAWINGS

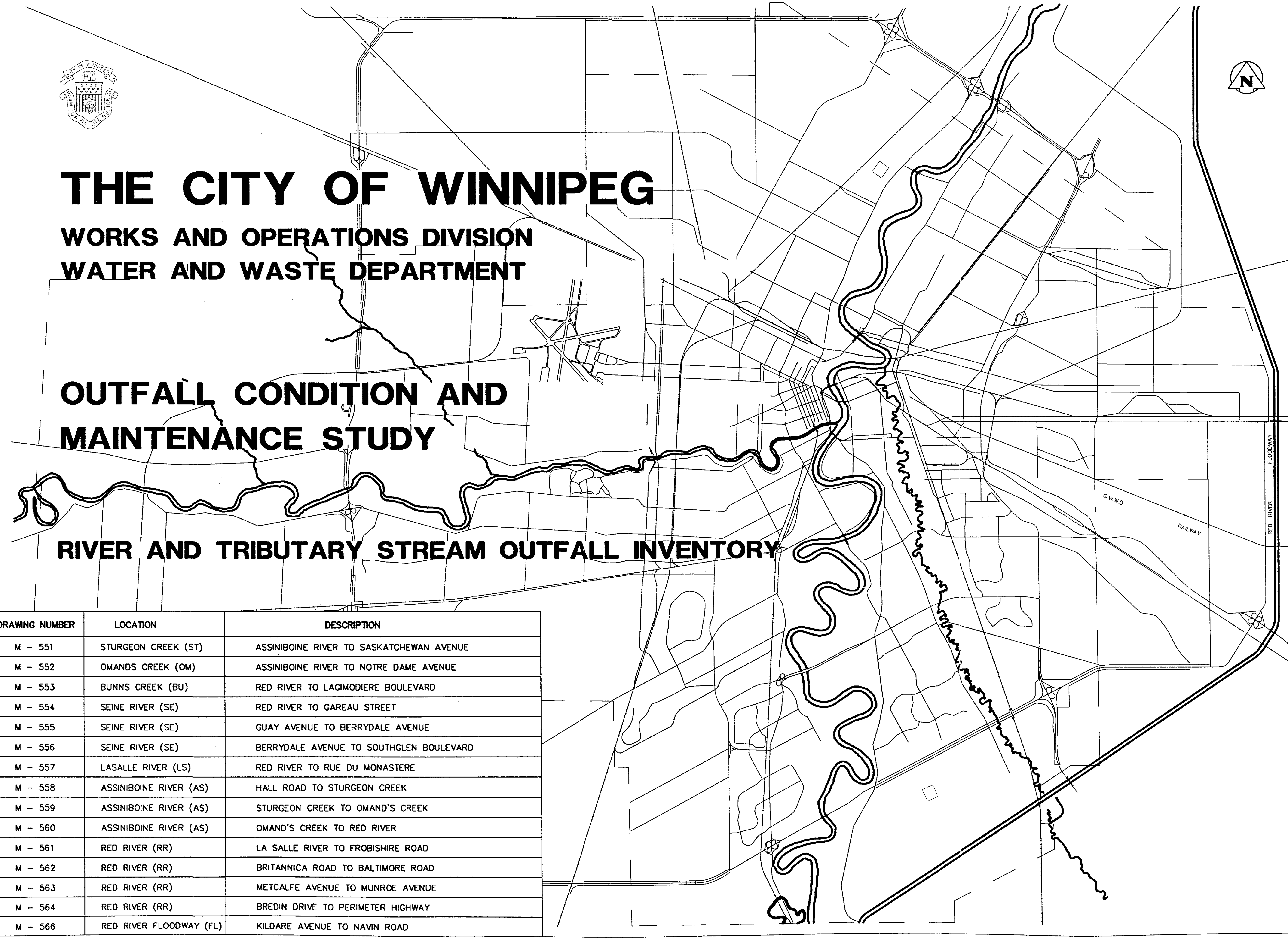
PROPERTY
OF THE
WATER & WASTE DEPARTMENT
RESOURCE CENTRE
1500 PLESSIS ROAD

THE CITY OF WINNIPEG

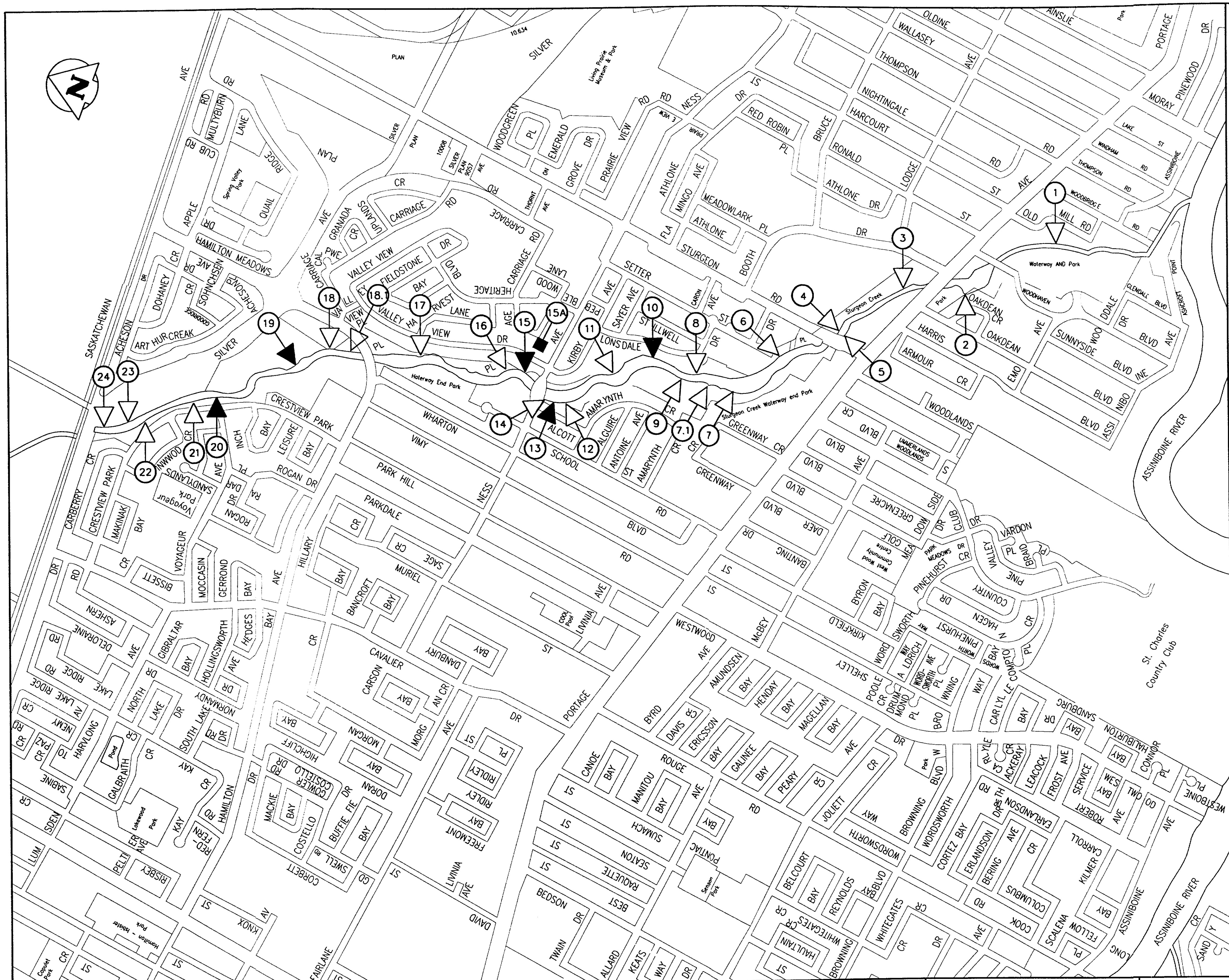
WORKS AND OPERATIONS DIVISION
WATER AND WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY

RIVER AND TRIBUTARY STREAM OUTFALL INVENTORY



DRAWING NUMBER	LOCATION	DESCRIPTION
M - 551	STURGEON CREEK (ST)	ASSINIBOINE RIVER TO SASKATCHEWAN AVENUE
M - 552	OMANDS CREEK (OM)	ASSINIBOINE RIVER TO NOTRE DAME AVENUE
M - 553	BUNNS CREEK (BU)	RED RIVER TO LAGIMODIERE BOULEVARD
M - 554	SEINE RIVER (SE)	RED RIVER TO GAREAU STREET
M - 555	SEINE RIVER (SE)	GUAY AVENUE TO BERRYDALE AVENUE
M - 556	SEINE RIVER (SE)	BERRYDALE AVENUE TO SOUTHGLEN BOULEVARD
M - 557	LASALLE RIVER (LS)	RED RIVER TO RUE DU MONASTERE
M - 558	ASSINIBOINE RIVER (AS)	HALL ROAD TO STURGEON CREEK
M - 559	ASSINIBOINE RIVER (AS)	STURGEON CREEK TO OMAND'S CREEK
M - 560	ASSINIBOINE RIVER (AS)	OMAND'S CREEK TO RED RIVER
M - 561	RED RIVER (RR)	LA SALLE RIVER TO FROBISHIRE ROAD
M - 562	RED RIVER (RR)	BRITANNICA ROAD TO BALTIMORE ROAD
M - 563	RED RIVER (RR)	METCALFE AVENUE TO MUNROE AVENUE
M - 564	RED RIVER (RR)	BREDIN DRIVE TO PERIMETER HIGHWAY
M - 566	RED RIVER FLOODWAY (FL)	KILDARE AVENUE TO NAVIN ROAD



OUTFALL ID. NO.	NAME	TYPE	SIZE
ST-1	OLD MILL RD.	LDS	400 DIA.
ST-2	OAKDEAN CRES.	LDS	300 DIA.
ST-3	BOOTH DR.	LDS	1850 DIA.
ST-4	STURGEON RD. (NORTH)	LDS	1500 DIA.
ST-5	STURGEON RD. (SOUTH)	LDS	1200 DIA.
ST-6	SETTER ST.	LDS	600 DIA.
ST-7	GREENWAY CRES. #1	LDS	600 DIA.
ST-7.1	GREENWAY CRES. #2	LDS	750 DIA.
ST-8	LONSDALE DR. #1	LDS	600 DIA.
ST-9	AMARYNTH CRES. #1	LDS	510 DIA.
ST-10	LONSDALE DR. #2	WWS	300 DIA.
ST-11	KIRBY DR.	LDS	600 DIA. & DITCH
ST-12	AMARYNTH CRES. #2	LDS	400 DIA.
ST-13	ALCOTT ST.	WWS	600 DIA.
ST-14	NESS AVE.	LDS	1900 DIA
ST-15	VALLEYVIEW DR. #1	WWS	600 DIA.
ST-15A	HERITAGE PUMPING STATION	WWS	
ST-16	VALLEYVIEW DR. #2	LDS	1050 & 125 DIA.
ST-17	HARVEST LANE	LDS	400 DIA.
ST-18	HAMILTON AVE. #1	LDS	1500 DIA.
ST-18.1	HAMILTON AVE. #2	LDS	400 DIA.
ST-19	SILVER AVE.	WWS	525 DIA.
ST-20	VOYAGEUR AVE.	WWS	600 DIA.
ST-21	CRESTVIEW PARK DR. (RETENTION POND DRAINAGE)	LDS	1675 DIA.
ST-22	CRESTVIEW PARK DR.	LDS	750 DIA.
ST-23	ACHESON DR.	LDS	400 DIA.
ST-24	SASKATCHEWAN AVE.	LDS	361 DIA.

LEGEND:

15 — WASTEWATER SEWER OVERFLOW OUTFALL (WWS)

14 — LAND DRAINAGE OUTFALL (LDS)

15A — LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY	CHECKED BY MD
DRAWN BY AP	APPROVED BY
HOR. SCALE: VERTICAL:	RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998	DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
—

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION
AND MAINTENANCE STUDY
STURGEON CREEK
ASSINIBOINE RIVER TO
SASKATCHEWAN AVE.

SHEET 1 OF 15

COMPUTER FILE NAME
M-551

CITY DRAWING NUMBER

OUTFALL ID. NO.	NAME	TYPE	SIZE
OM-1	RAGLAN RD.	LDS	400 DIA.
OM-2	CLIFTON ST. OVERFLOW	CS	2700 DIA.
OM-3	EMPRESS ST. #1	LDS	750 DIA.
OM-4	VELODROME #1	LDS	380 DIA.
OM-5	EMPRESS ST. #2	LDS	300 DIA.
OM-6	EMPRESS ST. #3	LDS	300 DIA.
OM-7	EMPRESS ST. #4	LDS	300 DIA.
OM-8	EMPRESS ST. #5	LDS	300 DIA.
OM-9	EMPRESS ST. #6	LDS	300 DIA.
OM-10	VELODROME METER PIT	LDS	100 DIA.
OM-11	VELODROME #2	LDS	300 DIA.
OM-12	EMPRESS ST. #7	LDS	300 DIA.
OM-13	EMPRESS ST. #8	LDS	300 DIA.
OM-14	EMPRESS ST. #9	LDS	300 DIA.
OM-15	EMPRESS ST. #10	LDS	300 DIA.
OM-16	EMPRESS ST. #11	LDS	300 DIA.
OM-17	EMPRESS ST. #12	LDS	300 DIA.
OM-18	EMPRESS ST. #13	LDS	300 DIA.
OM-19	EMPRESS ST. #14	LDS	300 DIA.
OM-20	WESTVIEW PARK CHANNEL	LDS	
OM-21	EMPRESS ST. #15	LDS	300 DIA.
OM-22	EMPRESS ST. #16	LDS	300 DIA.
OM-23	EMPRESS ST. #17	LDS	300 DIA.
OM-24	EMPRESS ST. #18	LDS	300 DIA.
OM-25	EMPRESS ST. #19	LDS	300 DIA.
OM-26	EMPRESS ST. #20	LDS	300 DIA.
OM-28	ABANDONED	LDS	

LEGEND:

9 — LAND DRAINAGE OUTFALLS (LDS)

2 — COMBINED SEWER OVERFLOW (CS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY
CHECKED BY MD
DRAWN BY AP
APPROVED BY
HOR. SCALE:
VERTICAL:
RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998
DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY

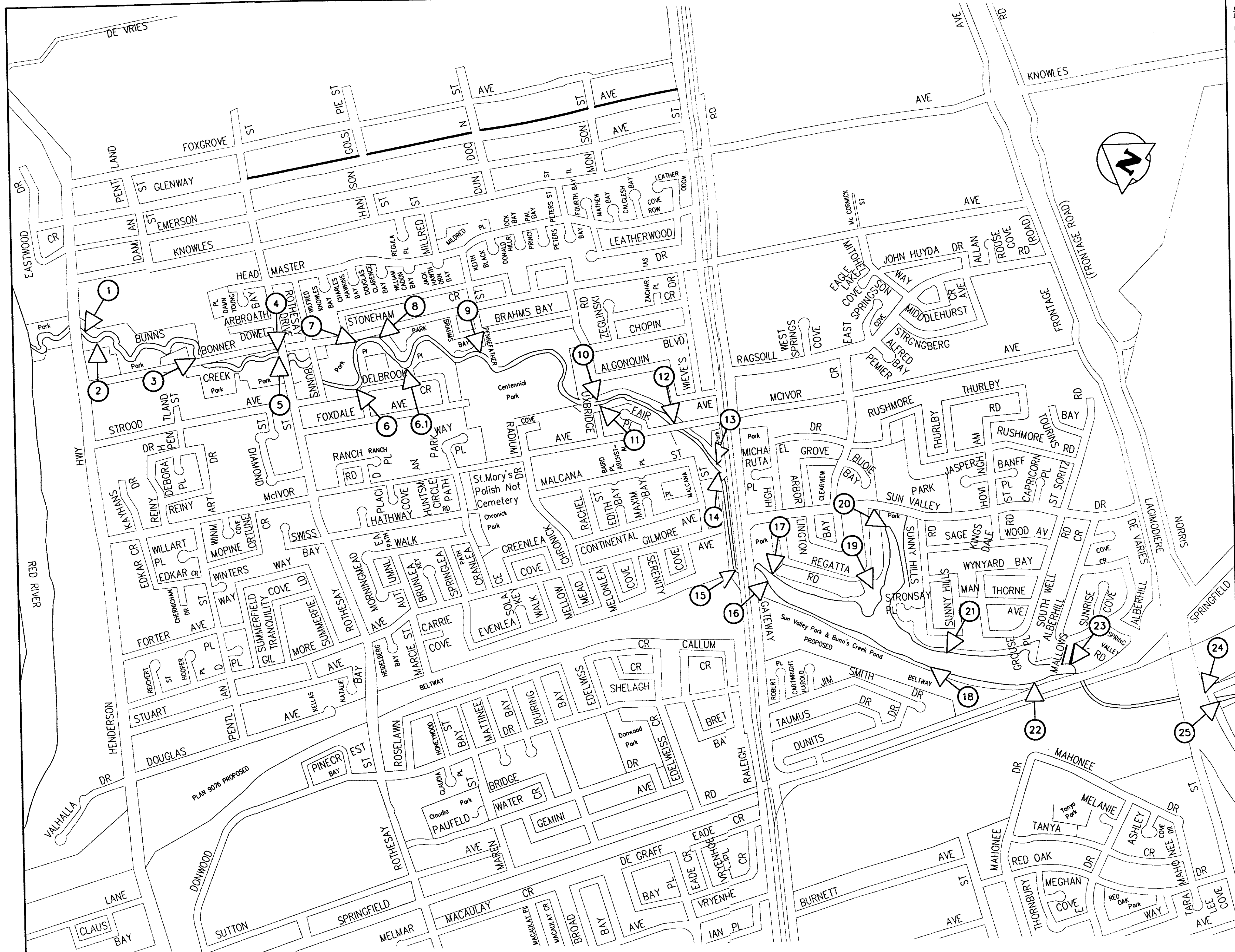
OMAND'S CREEK

ASSINIBOINE RIVER NORTH TO NOTRE DAME AVENUE

SHEET 2 OF 15

COMPUTER FILE NAME M-552

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
BU-1	HENDERSON HWY. #1	LDS	1375 DIA.
BU-2	HENDERSON HWY. #2	LDS	1200 DIA.
BU-3	BONNER AVE. #1	LDS	525 DIA.
BU-4	ROTHESAY ST. N.	LDS	1200 DIA.
BU-5	ROTHESAY ST. S.	LDS	1200 DIA.
BU-6	DELBROOK CRES. #1	LDS	400 DIA.
BU-6.1	DELBROOK CRES. #2	LDS	600 DIA.
BU-7	BONNER AVE. #2	LDS	400 DIA.
BU-8	BONNER AVE. #3	LDS	375 DIA.
BU-9	PENNEFATHER ST.	LDS	1350 DIA.
BU-10	UXBRIDGE RD. N.	LDS	1200 DIA.
BU-11	UXBRIDGE RD. S.	LDS	900 DIA.
BU-12	McIVOR AVE.	LDS	400 DIA.
BU-13	RALEIGH ST. #1	LDS	400 DIA.
BU-14	RALEIGH ST. #2	LDS	750 DIA.
BU-15	RALEIGH ST. #3	LDS	750 DIA.
BU-16	GATEWAY RD.	LDS	800 DIA.
BU-17	REGATTA RD. #1	LDS	300 DIA.
BU-18	JIM SMITH DR.	LDS	1390x975
BU-19	REGATTA RD. #2	LDS	300 DIA.
BU-20	SUN VALLEY DR.	LDS	1800 DIA.
BU-21	SUNNY HILLS RD.	LDS	725 DIA.
BU-22	WPG. HYDRO TRANSMISSION LINE	LDS	2125 DIA.
BU-23	MALLOWS WAY	LDS	900 DIA.
BU-24	KILCONA REGIONAL PARK LAKES	LDS	DITCH
BU-25	LAGIMODIERE BLVD.	LDS	DITCH

LEGEND:

(15)▷ LAND DRAINAGE OUTFALL (LDS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE | DATE

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B.M.
ELEV.

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KGS GROUP — CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

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CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY

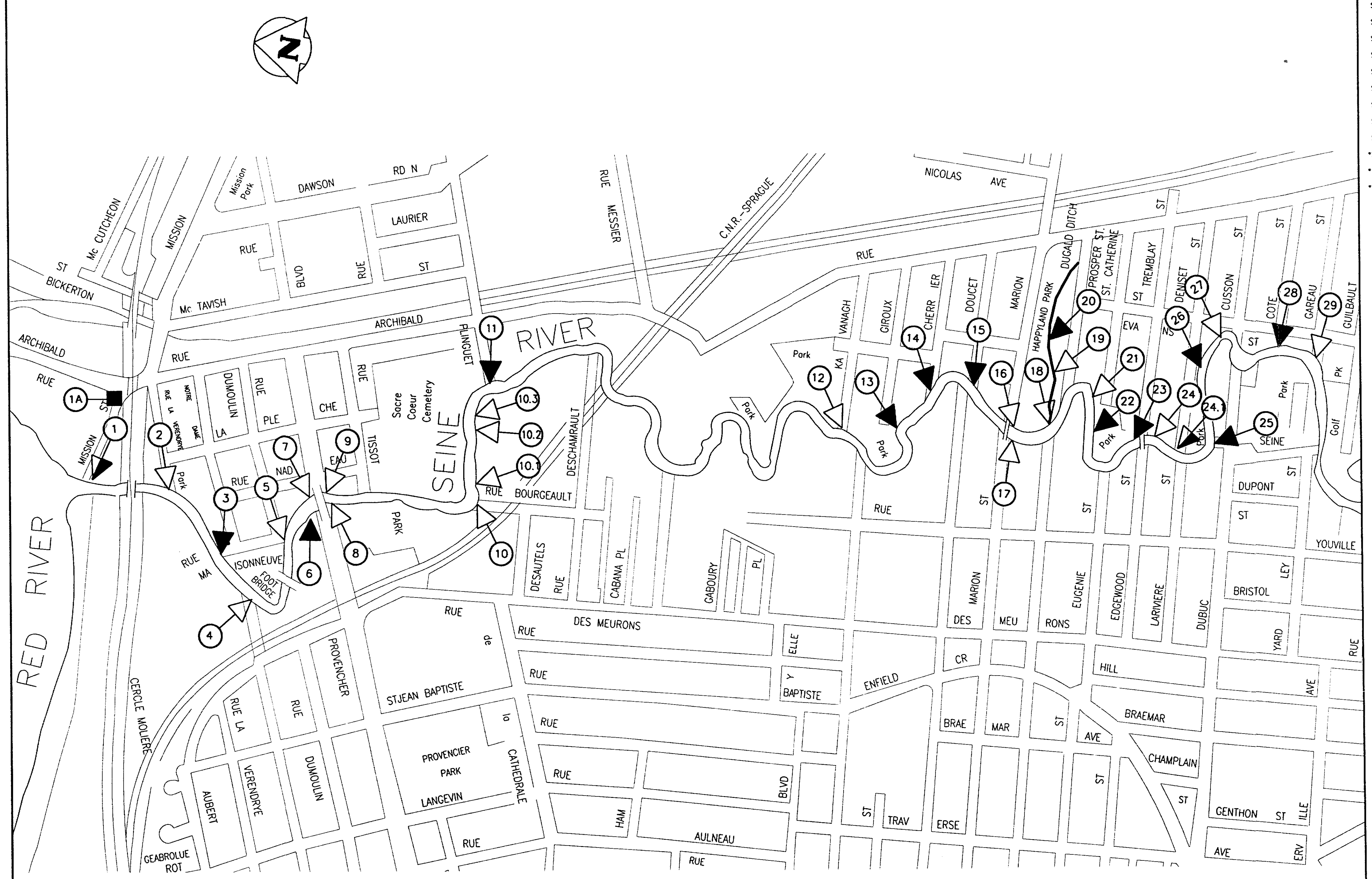
BUNNS CREEK

RED RIVER TO LAGIMODIERE BLVD.

SHEET 3 OF 15

COMPUTER FILE NAME
M-553

CITY DRAWING NUMBER



LEGEND:

44 — LAND DRAINAGE OUTFALL (LDS)

44 — WASTEWATER SEWER OVERFLOW OUTFALL (WWS)

45 — COMBINED SEWER OUTFALL (CS)

1A — FLOOD PUMPING STATION

OUTFALL ID. NO.	NAME	TYPE	SIZE
SE-1	MISSION FPS	CS	2600 DIA.
SE-1A	MISSION ST. – LIFT STATION	CS	300 DIA.
SE-2	RUE LAVERENDRYE	LDS	600 DIA.
SE-3	RUE NOTRE DAME E.	WWS	300 DIA.
SE-4	RUE NOTRE DAME W.	LDS	1220 DIA.
SE-5	RUE DUMOULIN	WWS	600 DIA.
SE-6	PROVENCHER BLVD. #1	WWS	300 DIA.
SE-7	PROVENCHER BLVD. #2	LDS	300 DIA.
SE-8	PROVENCHER BLVD. BRIDGE DRAINS	LDS	2-150 DIA.
SE-9	PROVENCHER BLVD. #3	LDS	300 DIA.
SE-10	RUE BOURGEAULT	LDS	450 DIA.
*SE-10.1	WESTEEL #1	LDS	400 DIA.
*SE-10.2	WESTEEL #2	LDS	450 DIA.
*SE-10.3	WESTEEL #3	LDS	300 DIA.
SE-11	RUE PLINGUET	CS	300 DIA.
SE-12	KAVANAGH ST.	LDS	750 DIA.
SE-13	GIROUX ST.	WWS	300 DIA.
SE-14	CHERRIER ST.	WWS	300 DIA.
SE-15	DOUCET ST.	WWS	300 DIA.
SE-16	MARION ST.	LDS	300 DIA.
SE-17	MARION ST. BRIDGE ABUTMENT	LDS	5-100 DIA.
SE-18	DUGALD DITCH ENTERS	LDS	
SE-19	DUGALD DITCH S. #1	LDS	300 DIA.
SE-20	DUGALD DITCH S. #2	WWS	300 DIA.
SE-21	ST. CATHERINE ST. #1	LDS	600 DIA.
SE-22	ST. CATHERINE ST. #2	WWS	300 DIA.
SE-23	TREMBLAY ST.	WWS	300 DIA.
SE-24	TREMBLAY ST. FOOTBRIDGE	LDS	CHANNELS
SE-24.1	DENISET ST. #1	CS	300 DIA.
SE-25	DUBUC ST.	WWS	300 DIA.
SE-26	DENISET ST. #2	WWS	300 DIA.
SE-27	EVANS AVE.	LDS	1067 DIA.
SE-28	COTE ST.	WWS	450 DIA.
SE-29	GAREAU ST.	LDS	800 DIA.

* – PRIVATE OUTFALL

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

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B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

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ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
SEINE RIVER
RED RIVER TO GAREAU ST.

SHEET 4 OF 15

COMPUTER FILE NAME
M-554

CITY DRAWING NUMBER

OUTFALL ID. NO.	NAME	TYPE	SIZE
SE-30	GUAY AVE.	LDS	750 DIA.
SE-30.1	EGERTON RD.	LDS	900 DIA.
SE-31	BLENHEIM AVE.	LDS	1060 DIA.
SE-32	IMPERIAL AVE.	LDS	750 DIA.
SE-33	HUMBOLT AVE.	LDS	900 DIA.
SE-34	RUE ARCHIBALD ST.	LDS	2700 DIA.
SE-34.1	BIBEAU DRAIN ENTERS	LDS	CHANNEL
SE-35	AVONDALE RD.	LDS	750 DIA.
SE-36	COMANCHE RD.	WWS	600 DIA.
SE-37	FERMOR AVE.	LDS	600 DIA.
SE-38	NIAKWA RD. #1	LDS	450 DIA.
SE-38.1	NIAKWA RD. #2	LDS	450 DIA
SE-39	MORROW AVE.	LDS	750 DIA.
SE-40	FERNWOOD AVE.	LDS	750 DIA.
SE-41	CLAYTON DR.	LDS	525 DIA.
SE-42	BERRYDALE AVE.	LDS	600 DIA.
SE-43	SOUTHBRIDGE DR.	LDS	900 DIA.

LEGEND:

44 — LAND DRAINAGE OUTFALLS (LDS)

36 — WASTEWATER SEWER OVERFLOW OUTFALL (WWS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE | DATE

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ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

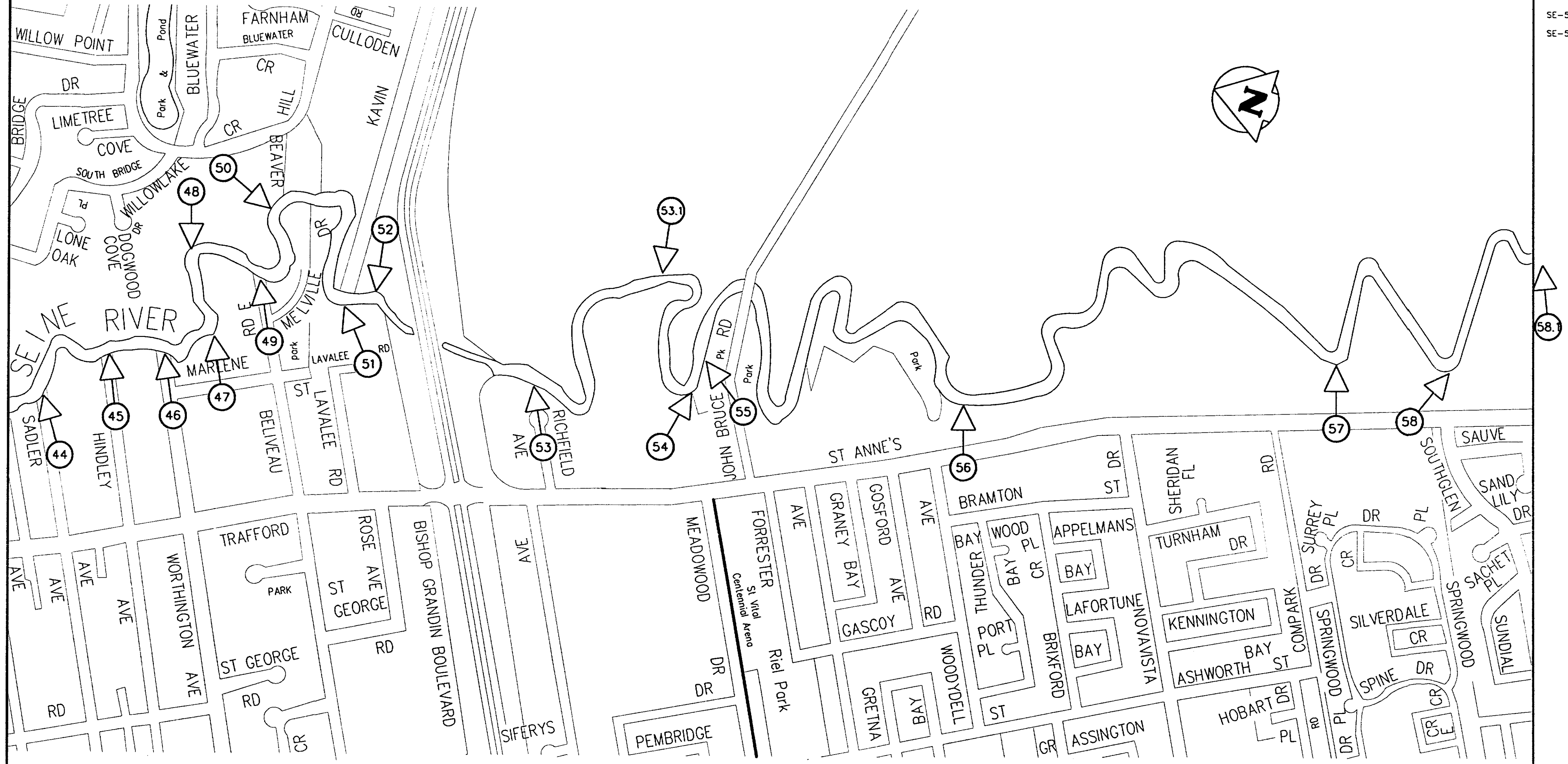
OUTFALL CONDITION AND MAINTENANCE STUDY
SEINE RIVER
GUAY AVE. TO BERRYDALE AVE.

SHEET 5 OF 15

COMPUTER FILE NAME M-555

CITY DRAWING NUMBER

OUTFALL ID. NO.	NAME	TYPE	SIZE
SE-44	SADLER AVE.	LDS	1050 DIA.
SE-45	HINDLEY AVE.	LDS	525 DIA.
SE-46	WORTHINGTON AVE.	LDS	750 DIA.
SE-47	MARLENE ST.	LDS	525 DIA.
SE-48	WILLOWLAKE CR.	LDS	1525 DIA.
SE-49	BELIVEAU RD.	LDS	1050 DIA.
SE-50	N. OF BEAVERHILL BLVD.	LDS	900 DIA.
SE-51	LAVALEE RD.	LDS	1200 DIA.
SE-52	BISHOP GRANDIN BLVD.	LDS	800 DIA. & DITCH
SE-53	RICHFIELD AVE.	LDS	1200 DIA.
SE-53.1	ROYALWOOD SUBDIVISION	LDS	450 DIA.
SE-54	PUBLIC LANE E. OF MEADOWOOD DR.	LDS	1200 DIA.
SE-55	N. OF JOHN BRUCE RD.	LDS	1200 DIA.
SE-56	WOODYDELL AVE.	LDS	1200 DIA.
SE-57	COMPARK RD.	LDS	1400 DIA.
SE-58	SOUTHGLEN DR.	LDS	1600 DIA.
SE-58.1	ST. ANNES RD.	LDS	2-1600 DIA.



LEGEND:

44 — LAND DRAINAGE OUTFALL (LDS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/C STRUCTURES COMMITTEE — DATE

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THUNDER BAY (807) 345-2233

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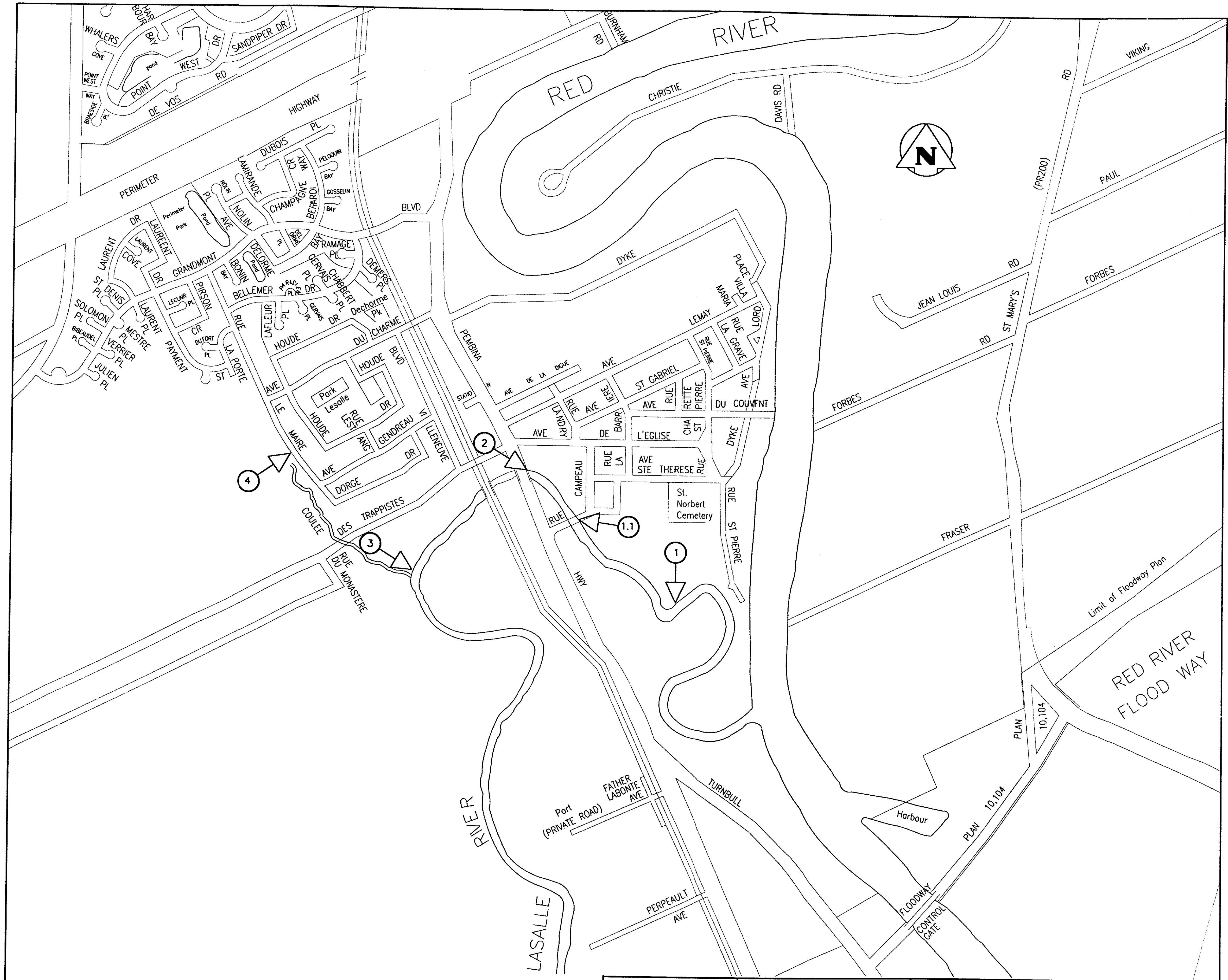
CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

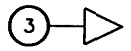
OUTFALL CONDITION AND MAINTENANCE STUDY
SEINE RIVER
BERRYDALE AVE. TO SOUTHGLEN BLVD.

SHEET 6 OF 15
COMPUTER FILE NAME M-556
CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
LS-1	RUE ST. PIERRE	LDS	300 DIA.
LS-1.1	RUE CAMPEAU	LDS	300 DIA.
LS-2	RUE DES TRAPPISTES	LDS	450 DIA.
LS-3	COULEE INTO LA SALLE RIVER	LDS	CHANNEL
LS-4	RUE LA MAIRE	LDS	1000 DIA.

LEGEND:

 LAND DRAINAGE OUTFALL (LDS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

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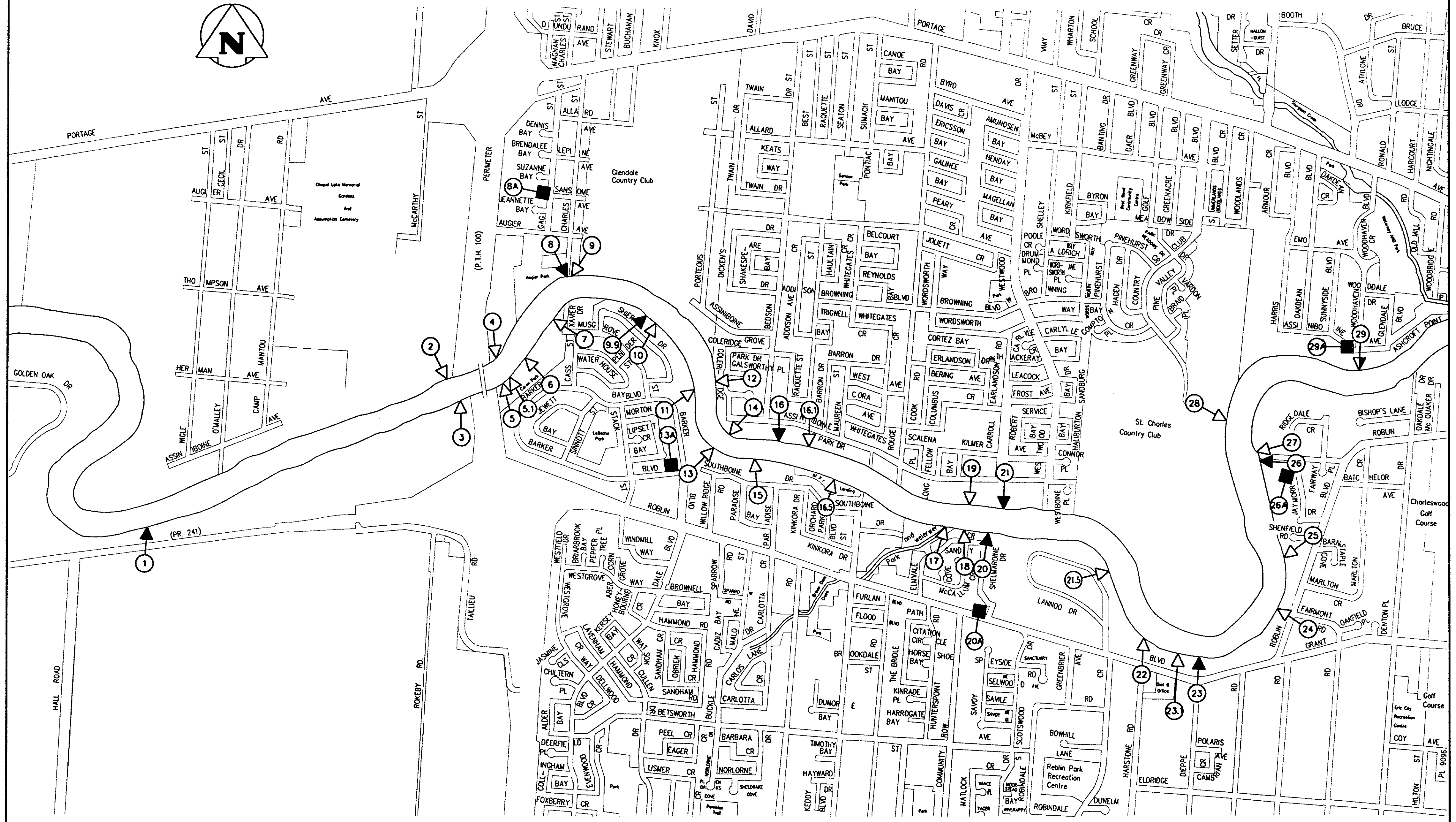
CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
LaSALLE RIVER
RED RIVER TO RUE DU MONASTERE

SHEET 7 OF 15
COMPUTER FILE NAME M-557
CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
AS-1	W.E.W.P.C.C. OUTFALL	TE	1500 DIA.
*AS-2	P.T.H. 100 W. SIDE #1	LDS	1400 DIA.
*AS-3	P.T.H. 100 W. SIDE #2	LDS	1350 DIA.
*AS-4	P.T.H. 100 E. SIDE #1	LDS	800 DIA.
*AS-5	P.T.H. 100 E. SIDE #2	LDS	1200 DIA.
*AS-5.1	P.T.H. 100 E. SIDE #3	LDS	1500 DIA.
AS-6	BARKER SPS	LDS	150 DIA.
AS-7	CARON PARK	LDS	150 DIA.
AS-8	ST. CHARLES ST.	WWS	250 DIA.
AS-8A	ST. CHARLES ST. LIFT STATION	WWS	
AS-9	ST. CHARLES ST. #2	LDS	900 DIA.
AS-9.9	SHIER DR.	WWS	250 DIA.
AS-10	PENDER ST.	LDS	900 DIA.
AS-11	BARKER BLVD.	LDS	1075 DIA.
AS-12	GALSWORTHY PL.	LDS	450 DIA.
AS-13	WILLOW RIDGE RD.	LDS	1800 DIA.
AS-13A	BARKER BLVD. LIFT STATION OVERFLOW	WWS	
AS-14	COLERIDGE PARK DR. SOUTH	LDS	450 DIA.
AS-15	PARADISE BAY	LDS	600 DIA.
AS-16	ABANDONED	WWS	450 DIA.
AS-16.1	RAQUETTE ST.	LDS	1800 DIA.
AS-16.5	ORCHARD PARK	LDS	600 DIA.
AS-17	BEAVER DAM CREEK ENTERS	LDS	
AS-18	McCALLUM CRESC.	LDS	1350 DIA.
AS-19	CARROLL RD.	LDS	1800 DIA.
AS-20	SHELMARDINE DR.	WWS	300 DIA.
AS-20A	COMMUNITY ROW LIFT STATION OVERFLOW	WWS	
AS-21	CARROLL RD. #2	WWS	300 DIA.
AS-21.5	LANNOO DR.	LDS	575x900
AS-22	HARSTONE RD.	LDS	450 DIA.
AS-23	DIEPPE RD. #2	WWS	900 DIA.
AS-23.1	DIEPPE RD. #1	LDS	600 DIA.
AS-24	FAIRMONT RD.	LDS	2500 DIA.
AS-25	SHENFIELD RD.	LDS	450 DIA.
AS-26	RIDGEDALE S.P.S.	WWS	250 DIA.
AS-26A	RIDGEDALE LIFT STATION	WWS	
AS-27	RIDGEDALE CRESC.	LDS	450 DIA.
AS-28	COUNTRY CLUB BLVD.	LDS	900 DIA.
AS-29	WOODHAVEN BLVD.	CS	450 DIA.
AS-29A	WOODHAVEN LIFT STATION	WWS	

* – PRIVATE OUTFALL

LEGEND:

- 33 – LAND DRAINAGE (LDS)
- 34 – WASTEWATER OVERFLOW (WWS)
- 58 – COMBINED SEWER OVERFLOW (CS)
- 8A – LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE   DATE

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B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

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CHECKED BY MD
DRAWN BY AP
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HOR. SCALE:
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DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. –

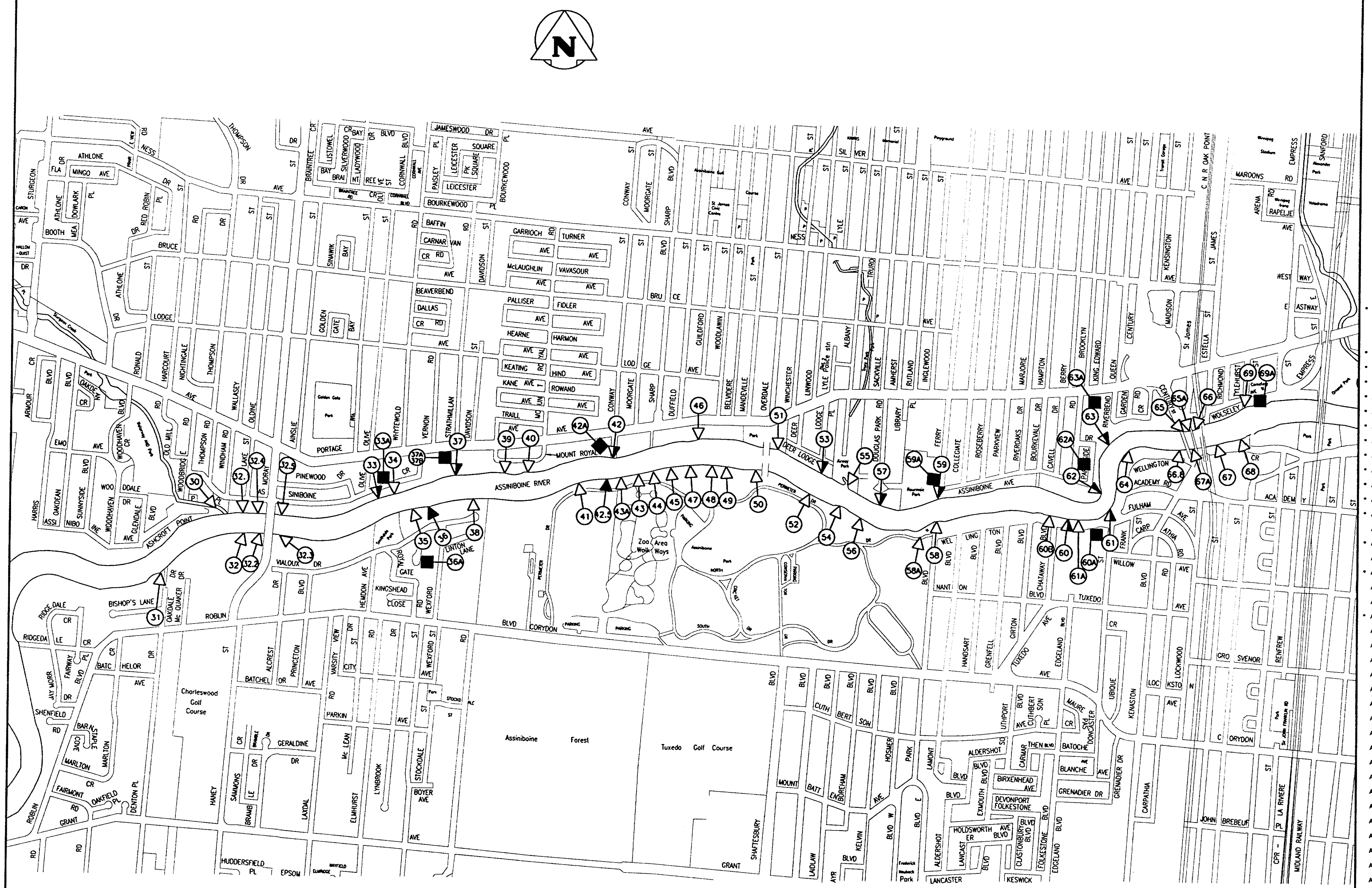
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
ASSINIBOINE RIVER
HALL ROAD TO STURGEON CREEK

SHEET 8 OF 15

COMPUTER FILE NAME
M-558

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
AS-30	STURGEON CREEK ENTERS	LDS	CHANNEL
AS-31	OAKDALE DR.	LDS	600 DIA.
AS-32	McQUAKER DR.	LDS	1050 DIA.
AS-32.1	ASSINIBOINE CRES.	LDS	300 DIA.
AS-32.2	CHARLESWOOD BRIDGE SW	LDS	250 DIA.
AS-32.3	CHARLESWOOD BRIDGE SE	LDS	250 DIA.
AS-32.4	CHARLESWOOD BRIDGE NW	LDS	250 DIA.
AS-32.5	CHARLESWOOD BRIDGE NE	LDS	250 DIA.
AS-33	OLIVE ST. #1	CS	750 DIA.
AS-33A	OLIVE ST. LIFT STATION	WWS	
AS-34	OLIVE ST. #2	LDS	2200 DIA.
AS-35	VIALOUX DR.	LDS	1500 DIA.
AS-36	WEXFORD S.P.S.	CS	250 DIA.
AS-36A	WEXFORD LIFT STATION	CS	250 DIA.
AS-37	STRATHMILLAN RD.	CS	900 DIA.
AS-37A	STRATHMILLAN COMMUNATOR CHAMBER OVERFLOW	CS	
AS-37B	STRATHMILLAN GATE CHAMBER	CS	300 DIA.
AS-38	VIALOUX DR. CUL-DE-SAC	LDS	750 DIA.
AS-39	MOUNT ROYAL CRES. #1	LDS	150 DIA.
AS-40	MOUNT ROYAL CRES. #2	LDS	250 DIA.
* AS-41	PERIMETER DR.-ASSINIBOINE PARK #1	LDS	DITCHDRAIN
AS-42	CONWAY CS	CS	2500 DIA.
AS-42A	CONWAY LIFT STATION	CS	
* AS-42.5	PERIMETER DR.-ASSINIBOINE PARK #2	CS	300 DIA.
* AS-43	N. PERIMETER DR. PUMPING STATION	LDS	300 DIA.
* AS-43A	ASSINIBOINE PARK DITCH DRAIN	LDS	400 DIA.
* AS-44	N. PERIMETER DR.-ASSINIBOINE PARK #1	LDS	300 DIA.
* AS-45	N. PERIMETER DR.-ASSINIBOINE PARK #2	LDS	450 DIA.
* AS-46	WOODLAWN ST.	LDS	300 DIA.
* AS-47	N. PERIMETER DR.-ASSINIBIONE PARK #3	LDS	150 DIA.
* AS-48	N. PERIMETER DR.-ASSINIBOINE PARK #4	LDS	150 DIA.
* AS-49	N. PERIMETER DR.-ASSINIBOINE PARK #5	LDS	150 DIA.
* AS-50	ASSINIBOINE PARK W. OF FOOT BRIDGE	LDS	150 DIA.
* AS-51	OVERDALE ST.	LDS	400 DIA.
* AS-52	ASSINIBOINE PARK #2	LDS	200 DIA.
AS-53	DEER LODGE PL.	CS	300 DIA.
* AS-54	ASSINIBOINE PARK #3	LDS	150 DIA.
AS-55	TRURO CREEK ENTERS	LDS	CHANNEL
* AS-56	ASSINIBOINE PARK #4	LDS	DITCH
AS-57	DOUGLAS PARK RD.	CS	300 DIA.
AS-58	PARK BLVD.	LDS	2400 DIA.
* AS-58A	ASSINIBOINE PARK DITCH DRAIN #2	LDS	300 DIA.
AS-59	FERRY RD.	CS	1800 DIA.
AS-59A	FERRY RD. PUMPING STATION	CS	
AS-60	CHATAWAY BLVD.	CS	900 DIA.
AS-60A	CHATAWAY BLVD. LIFT STATION	WWS	
AS-60B	CHATAWAY BLVD. #2	LDS	600 DIA.
AS-61	DONCASTER ST.	CS	2250 DIA.
AS-61A	EDGELAND BLVD.	LDS	400 DIA.
AS-62	PARKSIDE DR.	CS	750 DIA.
AS-62A	PARKSIDE DR. LIFT STATION	CS	
AS-63	RIVERBEND CRES.	CS	2250 DIA.
AS-63A	RIVERBEND LIFT STATION	CS	
AS-64	WELLINGTON CRES. #1	LDS	300 DIA.
AS-65	ST.JAMES UNDERPASS	LDS	900 DIA.
AS-65A	ROUTE 90 OVERPASS	LDS	300 DIA.
AS-66	KING EDWARD ST.	LDS	650 DIA.
AS-66.8	WELLINGTON CRES. #2	LDS	450 DIA.
AS-67	WELLINGTON CRES. AT CNR BRIDGE	LDS	450 DIA.
AS-67A	ROUTE 90 BRIDGE	LDS	450 DIA.
AS-68	WELLINGTON CRES. #3	LDS	500 DIA.
AS-69	TYLEHURST ST.	CS	2250 DIA.
AS-69A	TYLEHURST LIFT STATION	CS	

* – PRIVATE OUTFALL

LEGEND:

33 — LAND DRAINAGE (LDS)

36 — WASTEWATER OVERFLOW (WWS)

58 — COMBINED SEWER OVERFLOW (CS)

58C — LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP — CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY	CHECKED BY MD
DRAWN BY AP	APPROVED BY
HOR. SCALE: VERTICAL:	RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998	DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

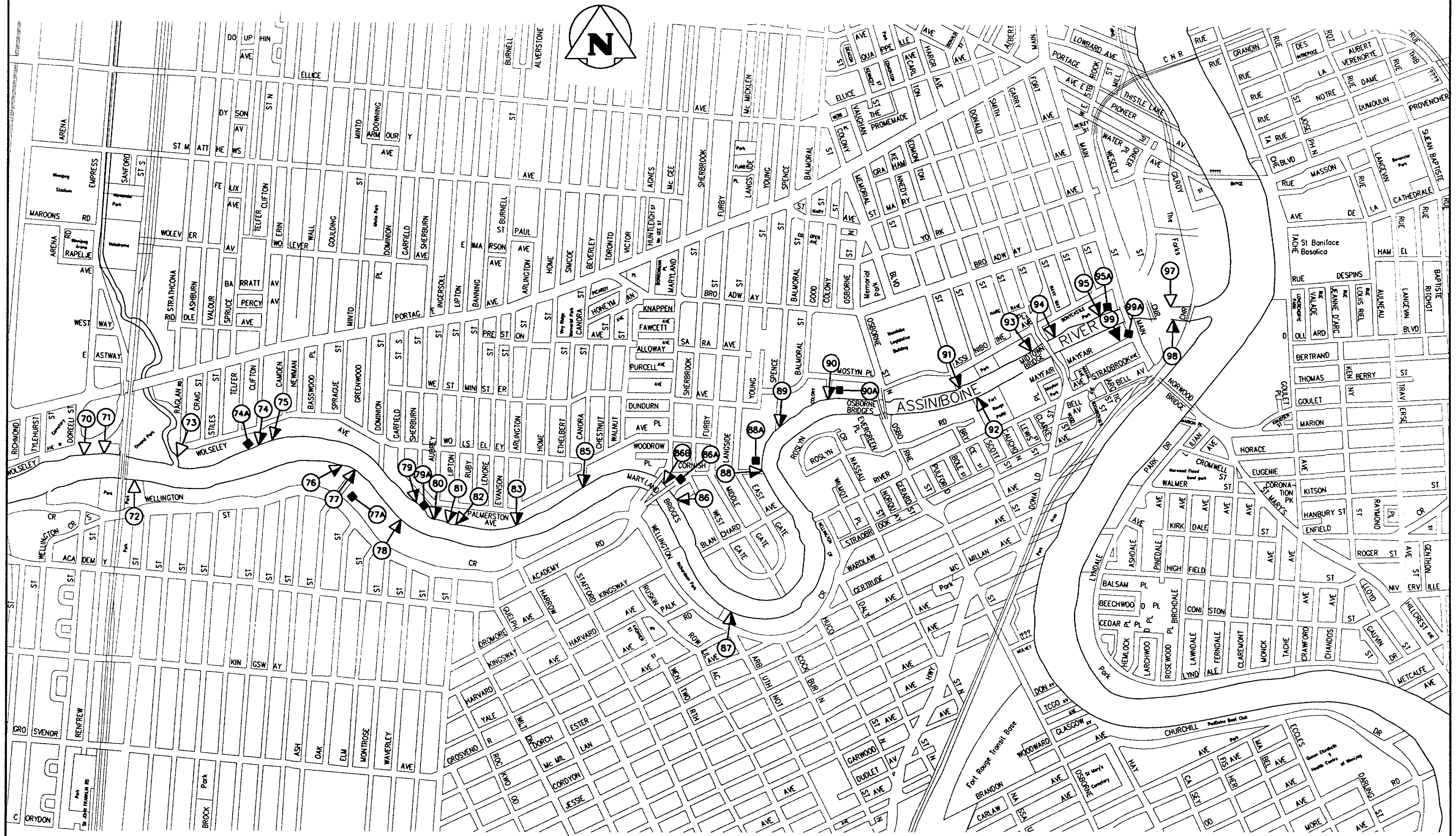
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION
AND MAINTENANCE STUDY
ASSINIBOINE RIVER
STURGEON CREEK TO OMAND'S CREEK

SHEET 9 OF 15

COMPUTER FILE NAME M-559

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
AS-70	EMPRESS ST. #1	LDS	300 DIA.
AS-71	EMPRESS ST. #2	LDS	300 DIA.
AS-72	RENFREW ST.	LDS	2400 DIA.
AS-73	OMAND'S CREEK ENTERS	LDS	CHANNEL
AS-74	CLIFTON ST. FPD	CS	2100 DIA.
AS-74A	CLIFTON LIFT STATION OVERFLOW	CS	
AS-75	CLIFTON ST.	CS	2300x2900
AS-76	ASH ST. FPS	CS	2100 DIA.
AS-77	ASH ST.	CS	3048x2900
AS-77A	ASH LIFT STATION OVERFLOW	CS	
AS-78	ELM ST.	CS	750 DIA.
AS-79	AUBREY ST.	CS	2900 DIA.
AS-79A	AUBREY LIFT STATION OVERFLOW	CS	
AS-80	AUBREY ST. FPS	CS	2100x2850
AS-81	RUBY ST. #1	CS	2100 DIA.
AS-82	RUBY ST. #2	CS	2700 DIA.
AS-83	ARLINGTON ST.	CS	375 DIA.
AS-85	CANORA ST.	CS	1975 DIA.
AS-86	CORNISH AVE. FPS	CS	1600 DIA.
AS-86A	CORNISH ST. LIFT STATION	CS	
AS-86B	MARYLAND ST.	CS	600 DIA.
AS-87	ARBUTHNOT ST.	CS	1400 DIA.
AS-88	CORNISH AVE.	CS	1500 DIA.
AS-88A	CORNISH LIFT STATION	CS	
AS-89	SPENCE ST.	CS	2700 DIA.
AS-90	COLONY ST.	CS	1800 DIA.
AS-90A	COLONY ST. FPS	CS	
AS-91	KENNEDY ST.	CS	750 DIA.
AS-92	FORT ROUGE PARK	CS	2400 DIA.
AS-93	HARGRAVE ST.	CS	700 DIA.
AS-94	DONALD ST.	CS	1900 DIA.
AS-95	ASSINIBOINE AVE. - FPD	CS	1200 DIA.
AS-95A	ASSINIBOINE AVE. - LIFT STATION	CS	
AS-97	THE FORKS E. OF C.N.R. BRIDGE	LDS	1200 DIA.
AS-98	THE FORKS E. OF C.N.R. BRIDGE (ABANDONED)	CS	1500x1000
AS-99	MAYFAIR AVE.	WWS	1200 DIA.
AS-99A	MAYFAIR AVE. - LIFT STATION	CS	

LEGEND:

33 LAND DRAINAGE (LDS)
34 WASTEWATER OVERFLOW (WWS)
58 COMBINED SEWER OVERFLOW (CS)
74A LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE   DATE

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ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY
CHECKED BY MD
DRAWN BY AP
APPROVED BY
HOR. SCALE:
VERTICAL:
RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998
DATE

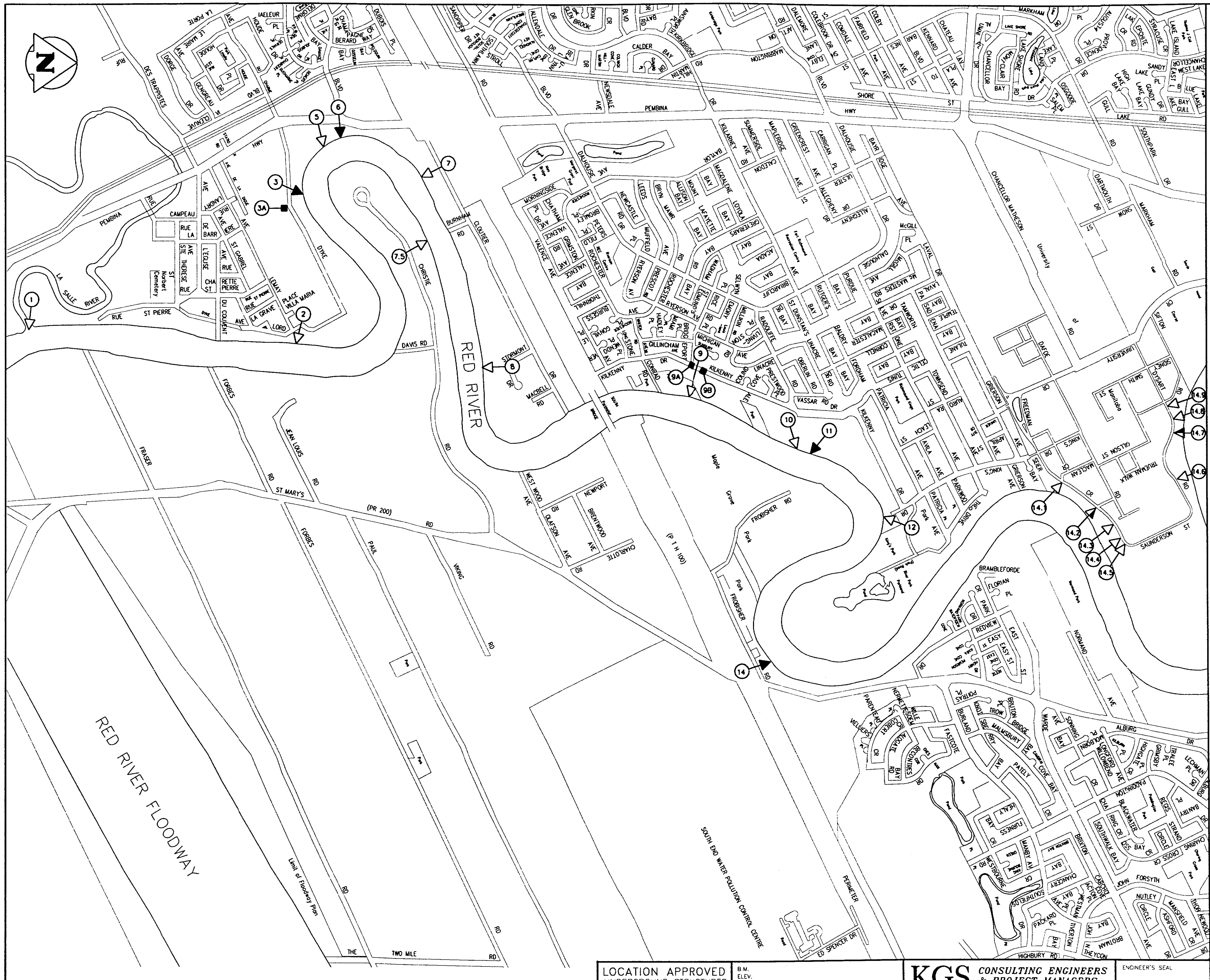
ENGINEER'S SEAL

CONSULTANT DRAWING NO.
—

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION
AND MAINTENANCE STUDY
ASSINIBOINE RIVER
OMAND'S CREEK TO RED RIVER

SHEET 10 OF 15
COMPUTER FILE NAME
M-560
CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
RR-1	LA SALLE RIVER ENTERS	LDS	CHANNEL
RR-2	LEMAY AVE.	LDS	900 DIA.
RR-3	ST. NORBERT X-KALAY LIFT STATION OVERFLOW	SANITARY	300 DIA.
RR-3A	ST. NORBERT X-KALAY LIFT STATION	SANITARY	
RR-4		DELETED	
RR-5	BEAUJOULAIS CREEK ENTERS	LDS	
RR-6	GRANDMONT BLVD.	SANITARY	750 DIA.
RR-7	CLOUTIER DR.	LDS	1800 DIA.
RR-7.5	CHRISTIE RD.	LDS	CHANNEL
RR-8	STORMONT DR.	LDS	400 DIA.
RR-9	RICE PLACE	LDS	1500 DIA.
RR-9A	KILKENNY DR. WASTEWATER SEWER OVERFLOW	LDS	
RR-9B	KILKENNY LIFT STATION	SANITARY	100 DIA.
RR-10	RADCLIFFE #1	LDS	1200 DIA.
RR-11	RADCLIFFE #2	WWS	750 DIA.
RR-12	KINGS DR.	LDS	1500 DIA.
RR-14	S.E.W.P.C.C. OUTFALL	TE	1800 DIA.
* RR-14.1	FREEDMAN CR. #1	LDS	
* RR-14.2	FREEDMAN CR. #2	CS	
* RR-14.3	SAUNDERSON ST. #1	LDS	
* RR-14.4	SAUNDERSON ST. #2	LDS	
* RR-14.5	SAUNDERSON ST. #3	LDS	
* RR-14.6	SIFTON RD. #1	LDS	
* RR-14.7	SIFTON RD. #2	CS	
* RR-14.8	SIFTON RD. #3	LDS	
* RR-14.9	SIFTON RD. #4	LDS	

* - PRIVATE OUTFALL

LEGEND:

33 LAND DRAINAGE (LDS)
34 WASTEWATER OVERFLOW (WWS)
58 COMBINED SEWER OVERFLOW (CS)
9B LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

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WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

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ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

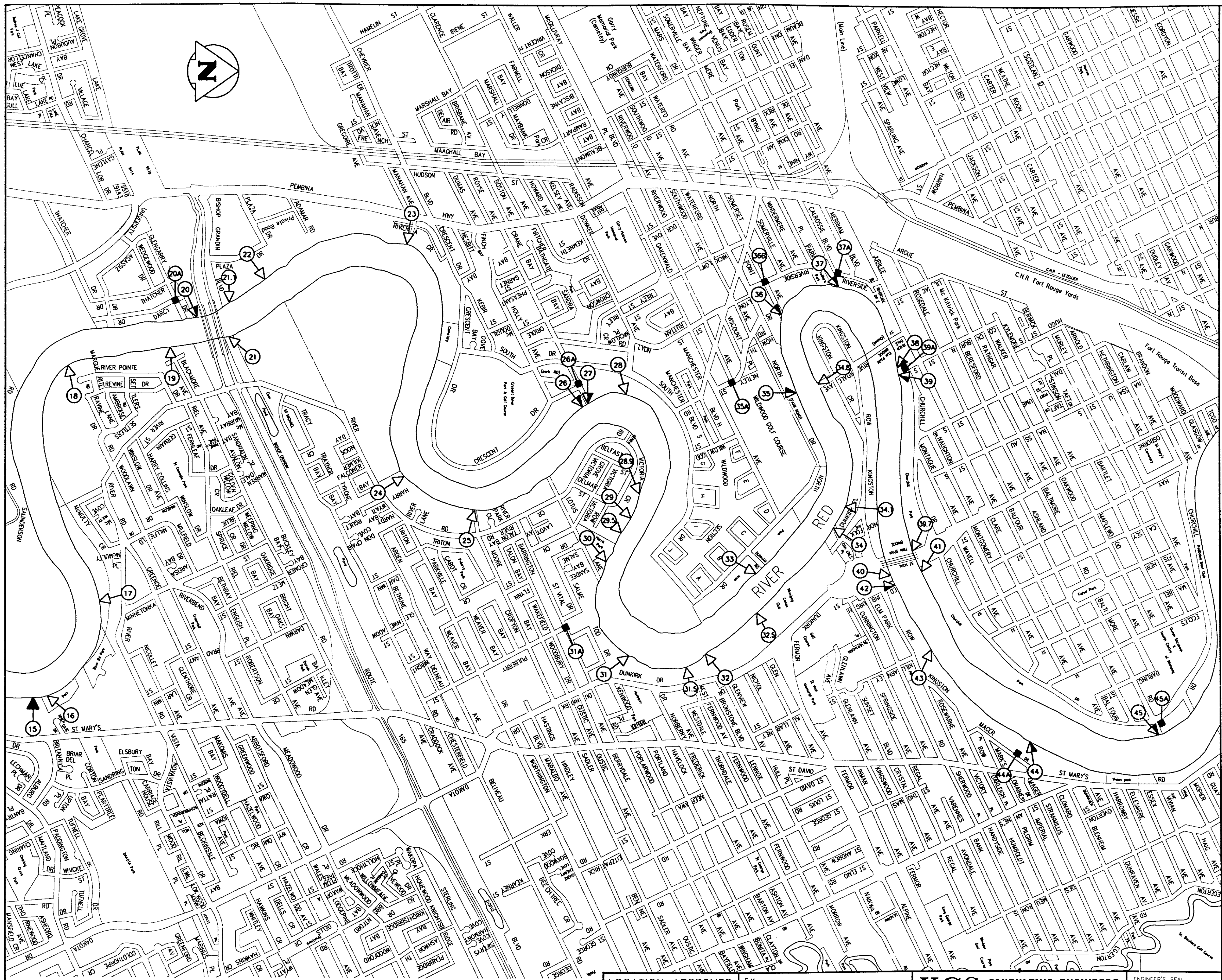
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER
LaSALLE RIVER TO FROBISHER ROAD

SHEET 11 OF 15

COMPUTER FILE NAME
M-561

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
RR-15	RIVERGATE DR.	WWS	1350 DIA.
RR-15A	S. ST. VITAL SRB CONTROL CHAMBER		
RR-16	ST. MARY'S RD.	LDS	2280 DIA.
RR-17	MINNETONKA ST.	LDS	2100 DIA.
RR-18	RIVER POINTE PL.	LDS	1050 DIA.
RR-19	BANNING RD.	LDS	1370 DIA.
RR-20	DARCY DR.	CS	2200 DIA.
RR-20A	DARCY DR.	CS	
RR-21	BISHOP GRANDIN BLVD. #2	LDS	750 DIA.
RR-21.1	BISHOP GRANDIN BLVD. #4	LDS	750 DIA.
RR-22	PLAZA DR.	LDS	2400 DIA.
RR-23	RIVIERA CRES. OUTFALL	LDS	2000 DIA.
RR-24	FALCONER BAY	LDS	1200 DIA.
RR-25	MOORE AVE.	LDS	1100 DIA.
RR-26	CRANE AVE. #1	CS	600 DIA.
RR-26A	CRANE AVE. LIFT STATION	WWS	
RR-27	CRANE AVE. #2	CS	900 DIA.
RR-28	DOWKER AVE.	LDS	900 DIA.
RR-28.9	VICTORIA CRES. (NOT FOUND)	LDS	
RR-29	VICTORIA CRES. #2	LDS	750 DIA.
RR-29.5	VICTORIA CRES. (NOT FOUND)	LDS	
RR-30	LOTUS LANE	LDS	600 DIA.
RR-31	DUNKIRK DR.	LDS	1400 DIA.
RR-31A	PULBERRY ST. LIFT STATION	WWS	
RR-31.5	FERNWOOD AVE. (ABANDONED)	WWS	
RR-32	GLENVIEW AVE.	LDS	525 DIA.
RR-32.5	FERMOR AVE.	LDS	1950 DIA.
RR-33	DUNHAM RD.	LDS	1200 DIA.
RR-34	OAKCREST PL.	LDS	375 DIA.
RR-34.1	KINGSTON ROW	LDS	300 DIA.
RR-34.8	RIVERDALE AVE.	LDS	600 DIA.
RR-35	WILDWOOD GOLF COURSE	CS	900 DIA.
RR-35A	WILLOW LIFT STATION OVERFLOW	WWS	
RR-36	SOMERSET AVE.	CS	1800 DIA.
RR-36B	SOMERSET AVE. LIFT STATION	CS	
RR-37	CALROSSIE BLVD.	CS	450 DIA.
RR-37A	CALROSSIE BLVD. M.H. AT RIVERSIDE DR.	CS	
RR-38	COCKBURN ST. FPS	CS	1500 DIA.
RR-39	COCKBURN ST. LIFT STATION	CS	1800 DIA.
RR-39A	COCKBURN ST. LIFT STATION & COMM. CHAMBER	CS	
RR-39.7	ST. VITAL BRIDGE	LDS	1600 DIA.
RR-40	KINGSTON ROW UNDERPASS	LDS	750 DIA.
RR-41	CHURCHILL DR. UNDERPASS	LDS	800 DIA.
RR-42	EDINBURGH ST.	CS	800 DIA.
RR-43	KILLARNEY ST.	LDS	1200 DIA.
RR-44	MAGER DR. FPS	CS	1800 DIA.
RR-44A	MAGER LIFT STATION GRAVITY OVERFLOW	CS	
RR-45	BALTIMORE FPS	CS	1800 DIA.
RR-45A	BALTIMORE LIFT STATION GRAVITY OVERFLOW	CS	

LEGEND:

33 LAND DRAINAGE (LDS)
34 WASTEWATER OVERFLOW (WWS)
58 COMBINED SEWER OVERFLOW (CS)
98 LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

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B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY
CHECKED BY MD
DRAWN BY AP
APPROVED BY
HOR. SCALE:
VERTICAL:
RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998
DATE

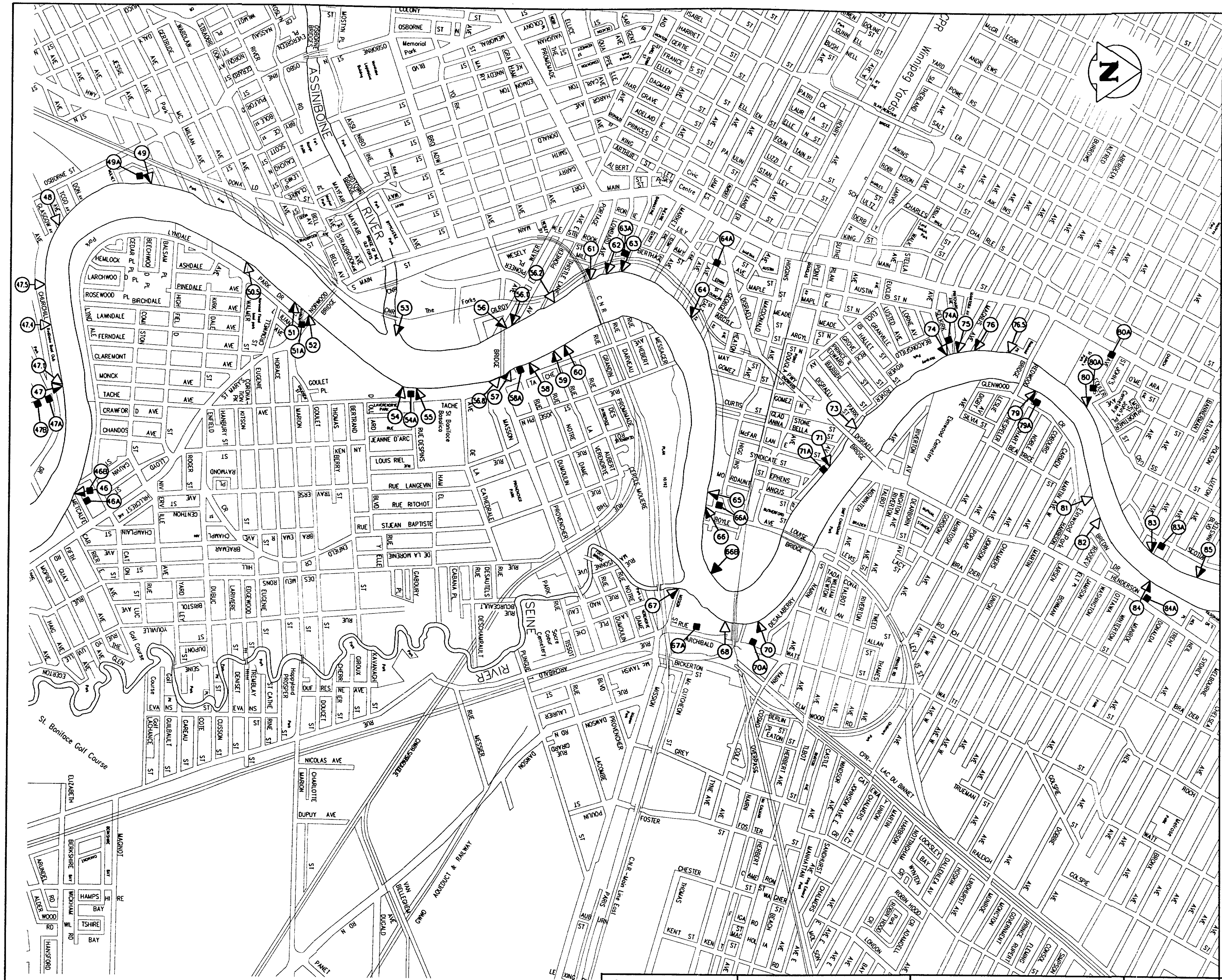
ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER
BRITANNICA ROAD TO BALTIMORE ROAD

SHEET 12 OF 15
COMPUTER FILE NAME M-562
CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
RR-46	METCALFE PL.	CS	2000 DIA.
RR-46A	METCALFE PL. FPS	CS	
RR-46B	METCALFE LIFT STATION OVERFLOW	CS	
RR-47	ECCLES ST.	CS	750 DIA.
RR-47A	OVERFLOW TO LDS ON CHURCHILL DR.	CS	
RR-47B	OVERFLOW TO LDS ON ECCLES ST.	CS	
RR-47.1	ECCLES ST. AT CHURCHILL DR.	LDS	1200 DIA.
RR-47.4	OPEN CULVERT FROM FOOTBALL FIELD	LDS	300 DIA.
RR-47.5	CHURCHILL HIGH SCHOOL	LDS	1600 DIA.
RR-48	GLASGOW AVE.	LDS	1200 DIA.
RR-49	JESSIE AVE.	CS	1900 DIA.
RR-49A	JESSIE LIFT STATION, FLOOD STATION & COMM. STATION	CS	
RR-50.5	PARK DR.	CS	1200 DIA.
RR-51	MARION ST. FPD	CS	1600 DIA.
RR-51A	MARION LIFT STATION	CS	
RR-52	MARION ST. #2	CS	1800 DIA.
RR-53	ASSINIBOINE RIVER ENTERS	CS	
RR-54	RUE DESPINS	CS	1400 DIA.
RR-54A	RUE DESPINS FPS	CS	
RR-55	RUE DESPINS FPD	CS	1200 DIA.
RR-56	WATER AVE. #1	CS	450 DIA.
RR-56.1	WATER AVE. #2	CS	450 DIA.
RR-56.2	PIONEER AVE.	LDS	1400 DIA.
RR-56.8	PROVENCHER BLVD.	LDS	
RR-57	RUE DUMOULIN FPD	CS	1200 DIA.
RR-58	RUE DUMOULIN	CS	1060 DIA.
RR-58A	RUE DUMOULIN FPS	CS	
RR-59	RUE LA VERENDRYE	LDS	1200 DIA.
RR-60	RUE LA VERENDRYE FPS	CS	600 DIA.
RR-61	LOMBARD AVE.	CS	900 DIA.
RR-62	MCDERMOT AVE.	CS	2700 DIA.
RR-63	BANNATYNE AVE.	CS	1500 DIA.
RR-63A	BANNATYNE AVE. FPS	CS	
RR-64	GALT AVE. FPS	CS	1500 DIA.
RR-64A	ALEXANDER AVE. COMM. CHAMBER OVERFLOW	CS	
RR-65	BOYLE ST. FPS (ABANDONED)	CS	1050 DIA.
RR-66	BOYLE ST. (ABANDONED)	CS	900 DIA.
RR-66A	BOYLE ST. LIFT STATION OVERFLOW	ABANDONED	
* RR-66B	GATEWAY INDUSTRIES PROCESS DISCHARGE	WWS	200 DIA.
RR-67	SEINE RIVER ENTERS	CS	
RR-67A	MONTCALM LIFT STATION OVERFLOW	CS	
RR-68	ARCHIBALD UNDERPASS	LDS	750 DIA.
RR-69		ABANDONED	
RR-70	WATT ST.	CS	3700 DIA.
RR-70A	ROLAND FPS	CS	
RR-71	SYNDICATE ST. FPD	CS	1800 DIA.
RR-71A	SYNDICATE ST. - LIFT STATION	CS	
RR-73	DISRAELI BRIDGE	LDS	300 DIA.
RR-74	SELKIRK AVE.	CS	1800 DIA.
RR-74A	SELKIRK AVE. FPS	CS	
RR-75	PRITCHARD AVE.	CS	250 DIA.
RR-76	BURROWS AVE.	CS	2400 DIA.
RR-76.5	ABERDEEN AVE.	LDS	200 DIA.
RR-79	HART AVE.	CS	2850x2150
RR-79A	HART AVE. FPS-COMM. STATION	CS	
RR-80	ST. JOHN'S PARK M.H.	CS	3000 DIA.
RR-80A	ST. JOHN'S COMM. CHAMBER OVERFLOW	CS	
RR-80A	ST. JOHN'S FPS	CS	
RR-81	ELMWOOD PARK	LDS	900 DIA.
RR-82	BREDIN DR.	LDS	450 DIA.
RR-83	POLSON AVE. FPS	CS	1800 DIA.
RR-83A	POLSON AVE. COMM. CHAMBER OVERFLOW	CS	
RR-84	MUNROE AVE. FPS	CS	2500 DIA.
RR-84A	MUNROE AVE. COMM. CHAMBER OVERFLOW	CS	
RR-85	INKSTER BLVD.	CS	2900 DIA.

* - PRIVATE OUTFALL

LEGEND

- 33 LAND DRAINAGE (LDS)
- 34 WASTEWATER OVERFLOW (WWS)
- 58 COMBINED SEWER OVERFLOW (CS)
- 98 LIFT STATION

LOCATION APPROVED UNDERGROUND STRUCTURES

SUPV. U/C STRUCTURES COMMITTEE DATE

NOTE:
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B.M. ELEV.

NO. REVISIONS DATE BY

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY | CHECKED BY MD
DRAWN BY AP | APPROVED BY
HOR. SCALE: VERTICAL: | RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998 | DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
—

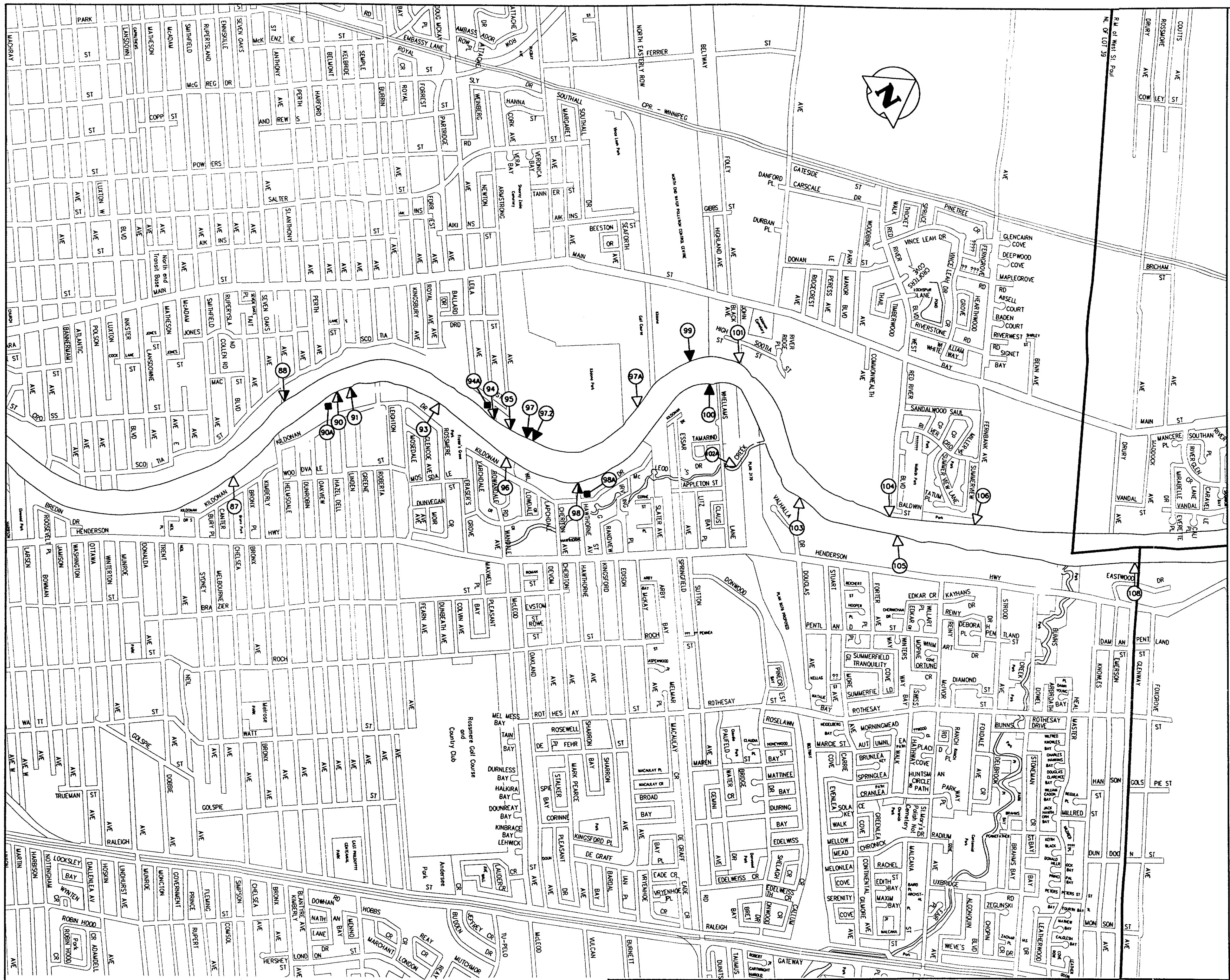
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER
METCALFE AVE. TO MUNROE AVE.

SHEET 13 OF 15

COMPUTER FILE NAME
M-563

CITY DRAWING NUMBER



OUTFALL ID. NO.	NAME	TYPE	SIZE
RR-87	CHELSEA PL.	LDS	2275 DIA.
RR-88	JEFFERSON AVE.	CS	3300 DIA.
RR-90	LINDEN AVE.	CS	1800 DIA.
RR-90A	LINDEN AVE. - LIFT STATION	CS	
RR-91	LINDEN AVE. - FPD	CS	1675 DIA.
RR-93	ROSSMERE CRES.	LDS	2900 DIA.
RR-94	NEWTON AVE.	CS	1850 DIA.
RR-94A	NEWTON AVE. - LIFT STATION	CS	
RR-95	ARMSTRONG AVE.	CS	2700 DIA.
RR-96	LARCHDALE CRES. SPS	LDS	1050 DIA.
* RR-97	KILDONAN PARK #1	LDS	250 DIA.
* RR-97A	BERLEN CUT-OFF (ABANDONED)	LDS	
RR-97.2	KILDONAN PARK #2	WWS	250 DIA.
RR-98	HAWTHORNE AVE.	CS	2200 DIA.
RR-98A	HAWTHORNE AVE. - LIFT STATION	CS	
RR-99	N.E.W.P.C.C. OUTFALL KILDONAN GOLF COURSE	TE	1200x3350
RR-100	WHELLAMS LANE	WWS	1200 DIA.
RR-101	JOHN BLACK AVE.	LDS	1800 DIA.
RR-102A	McLEOD'S CREEK	LDS	
RR-103	VALHALLA DR.	LDS	1675 DIA.
RR-104	RED RIVER BLVD.	LDS	750 DIA.
* RR-105	HENDERSON HWY. (PRIVATE)	LDS	600 DIA.
RR-106	SUMMERVIEW LANE	LDS	1800 DIA.
RR-108	EASTWOOD DR.	LDS	525 DIA.

* - PRIVATE OUTFALL

LEGEND

33 LAND DRAINAGE (LDS)

34 WASTEWATER OVERFLOW (WWS)

58 COMBINED SEWER OVERFLOW (CS)

98 LIFT STATION

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY
CHECKED BY MD
DRAWN BY AP
APPROVED BY
HOR. SCALE:
VERTICAL:
RELEASED FOR CONSTRUCTION:
DATE AUGUST 20, 1998
DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER
BREDIN DR. TO PERIMETER HWY.

SHEET 14 OF 15

COMPUTER FILE NAME
M-564

CITY DRAWING NUMBER

OUTFALL ID. NO.	NAME	TYPE	SIZE
FL-1	DEACON RESERVOIR	LDS	1500 DIA.
FL-2	KILDARE AT FLOODWAY	LDS	3000 DIA.

LEGEND:

(14) LAND DRAINAGE OUTFALL (LDS)

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

DESIGNED BY
CHECKED BY MD
DRAWN BY AP
APPROVED BY
HOR. SCALE:
VERTICAL:
RELEASED FOR CONSTRUCTION
DATE AUGUST 20, 1998
DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO. —

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
WATER & WASTE DEPARTMENT

OUTFALL CONDITION AND MAINTENANCE STUDY
RED RIVER FLOODWAY
KILDARE AVENUE TO NAVIN ROAD

SHEET 15 OF 15
COMPUTER FILE NAME M-566
CITY DRAWING NUMBER

APPENDIX B
Rating Guidelines &
Inspection Form

APPENDIX B

RATING GUIDELINES AND INSPECTION FORM

Condition Rating Reference Report

Structural Condition Rating Guidelines

Ranking	Observed Performance Defects
1	Insignificant deformation in outfall pipe (< 2%) Evidence of dropped invert of outfall by < 2 cm Fractures in concrete pipe up to 2 mm Horizontal displacement at joint - no gap present Vertical displacement at joint - no gap present Minor evidence of ice impact; opening reduced by < 5%
2	Minor Deformation in outfall pipe (< 3%) Evidence of dropped invert of outfall by 2 - 5 cm Fractures in concrete pipe 2 -5 mm Horizontal displacement at joint with minor gap < 5 mm Vertical displacement at joint - minor gap < 5 mm Minor evidence of ice impact; opening reduced 5 - 10 %
3	Moderate Deformation in outfall pipe (< 4%) Evidence of dropped invert of outfall by 5 - 15 cm Fractures in concrete pipe 5 - 8 mm Horizontal displacement at joint with gap 5 to 15 mm Vertical displacement at joint with gap 5 to 15 mm Moderate evidence of ice impact; opening reduced 10 - 20 %
4	Significant Deformation in outfall pipe (< 5%) Evidence of dropped invert of outfall 15 - 20 cm Fractures in concrete pipe 8 - 10 mm Horizontal displacement or at joint with gap 15 to 25 mm Vertical displacement at joint with gap 15 to 25 mm Moderate evidence of ice impact; opening reduced 20 - 30 %
5	Severe Deformation in outfall pipe (> 5%) Evidence of dropped invert of outfall by >20 cm Fractures in concrete pipe > 1 cm Horizontal displacement or at joint with gap > 25 mm Vertical displacement or at joint with gap > 25 mm Severe evidence of ice impact; opening reduced > 30 %

In the above table, each RANKING category has 6 sub-conditions which would subject the Structural Rating for the outfall pipe to the particular ranking. For each ranking, the outfall pipe needs only to be categorized by one of the sub-conditions in order to be ranked. For example, an outfall pipe that has experienced a gap of 3-5 mm at a particular joint would be structurally rated a 1, provided that the condition respective to distortion, out-of-round, invert settlement, cracking or ice impacts is less severe. An outfall should be Structurally Rated on the basis of a worst case scenario. Comments entered in the comments field should describe in detail observed defects

Condition Rating Reference Report

Stream Condition Rating Guidelines

Ranking	Observed Performance Defects
1	Minor erosion - erosion between 20 and 30 metres from the outfall
2	Moderate erosion - erosion between 10 and 20 metres from the outfall
3	Significant erosion - erosion within 10 metres from the outfall
4	Severe erosion - erosion at the outfall
5	Critical erosion - structure is being undermined

Riverbank Condition Rating Guidelines

Ranking	Observed Performance Defects
1	Minimal risk of failure - only minor bank improvements required
2	Low risk of failure - stability safety factor considered to be adequate, but bank improvements will prevent long term deterioration
3	Moderate risk of failure - stability safety factor considered to be above unit under extreme conditions, but bank improvements warranted
4	High risk of failure - Stability safety factor considered to close to unity under extreme conditions (historical bank movements apparent)
5	Failure condition - active bank failures impacting on outfall, excessive distress apparent

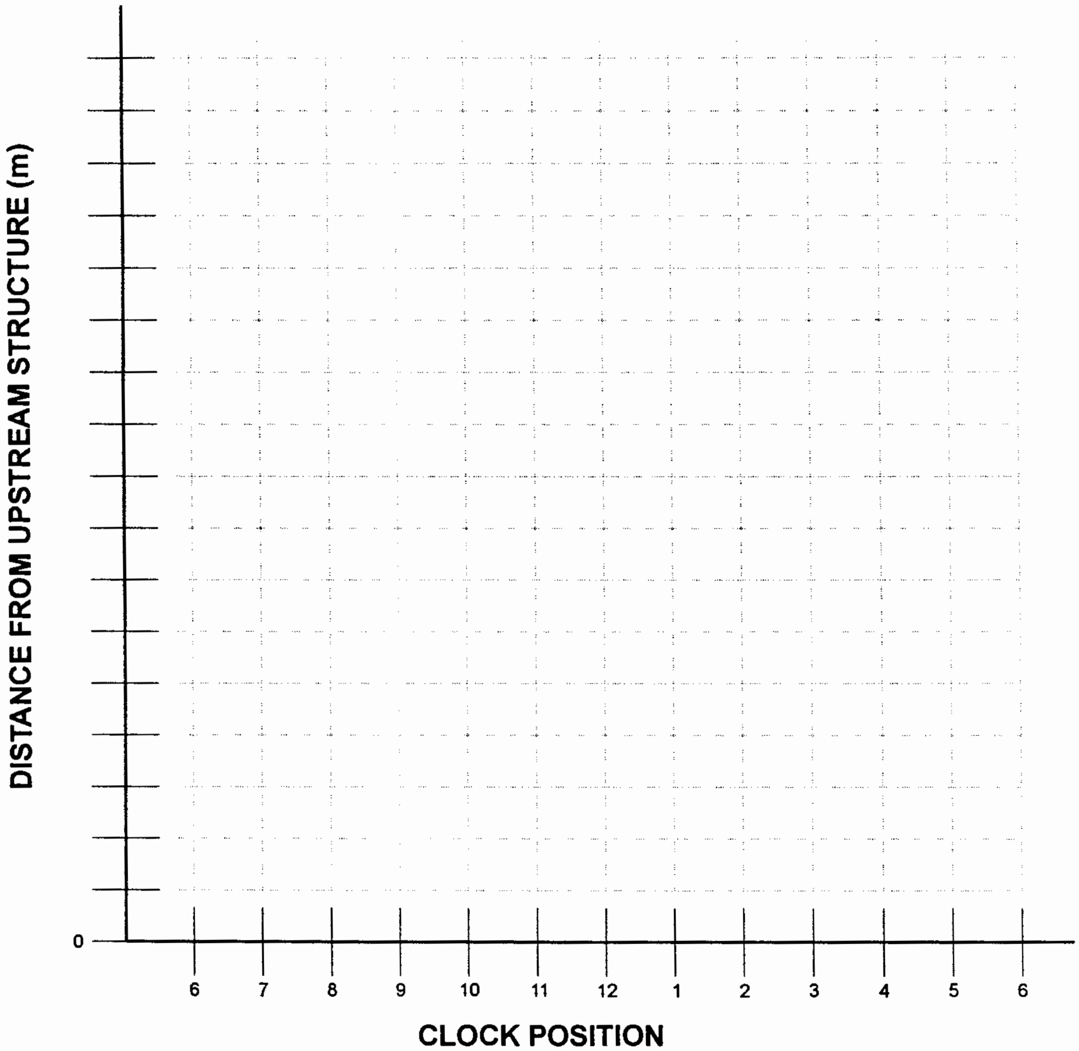
Overall Condition Rating

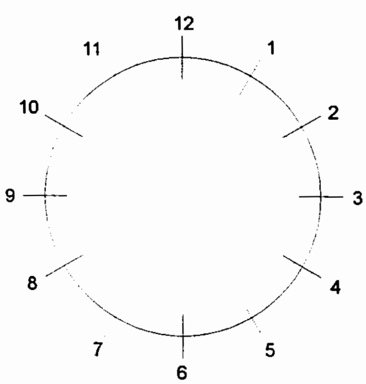
The Overall Rating for the outfall will be assessed automatically by the database. The criteria set for the Overall Rating is based on the worst case scenario. That is, if the Structural Rating is a 4, the Stream Rating is a 3, and the Riverbank Rating is a 3, then the Overall Rating will be a 4 based on the worst condition rating found during the inspection. It can be concluded that all three rating categories are considered equally important for the overall condition of the outfall.

Outfall Name: ______________ **Location:** ____________________

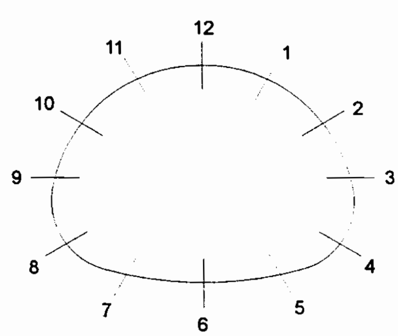
Stream: ______________ **Date:** ____________________

STRUCTURE CONDITION MAPPING CHART





Clock Reference
Looking
Downstream



Clock Reference
Looking
Downstream

LEGEND:

DEFECTIVE CONCRETE:	SPALLING	SP	**JOINTS:**	OPEN	JO
	HONEYCOMB	HC		DISPLACED	JD
	EROSION/WEAR	EW		SPALLED	SP
	DELAMINATED	DC			

HOW TO INTERPRET THE

STRUCTURE CONDITION MAPPING CHART

Definition

The structure condition mapping chart represents a detailed log of all structural anomalies inside the outfall pipe. It is used to record any noted cracks, displaced joints, pipe deformations, mis-alignments, etc.

Interpretation

The y-axis represents the position of the anomaly with respect to the closest access structure (ie., manhole, gate chamber, etc.) upstream of the outfall outlet. The zero position is defined by the access structure, and the outlet of the outfall represents the farthest distance or the greatest number on the y-axis

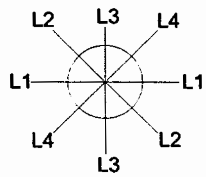
The x-axis represents the radial position of the anomaly with respect to its clock position inside the pipe as shown on the clock reference diagrams below the chart. In essence, the chart represents the mapping of all structural anomalies as if the pipe were to be cut longitudinally along the axis at the 6 o'clock position and laid flat.

For example, a longitudinal crack exists at the 3 o'clock position 10 metres from the gate chamber, and continues at roughly the same clock position for 5 metres. If the crack thickness (gap) is 5 mm, then a solid line would be drawn on the graph from (3,10) to (3,15) and labelled **5 mm crack**.

Water and Waste Department
Outfall Condition and Maintenance Study
INSPECTION FORM[1]

Inspector:					**Date:**	
Party Members:						
Temp.	**Weather:**					
Outfall ID No:		**Location:**			**Owner:**	
Type: *LDS CS SO TS*		**Stream:**				
Segment No.	**LBIS No.**	**Shape**	**D_1 or W**	**D_2 or H**	**Length**	**Material**
1						
2						
3						

Invert of outfall (m):		**Sag depth (m):**		**Grates:** *Y N*	
Deformation (mm)		**Sta.______**	**Sta.______**	**Sta._____**	**Sta._______**
	L1				
	L2				
	L3				
	L4				



Ice Damage: *Y N*	**Description:**	
Hydraulic restrictions:	1. - *partial collapse of the pipe*	
	2. - *sediment built up in the pipe*	
	3. - *severe restriction - vegetation*	

Geotechnical Features

Bank Height	River Section	Slope	Slump	Erosion	Vegetation	Instrumentation
	Straight Outside Bend Inside Bend	1V:2H 1V:3H 1V:4H 1V:5H	Deep Seated Active Inactive Shallow Hummocky Stable Retrogressive	Toe Scour Undercutting Slope Rills	Mature Trees Scrub Brush Grass	Inclinometer Piezometer

COMMENTS OR DESCRIPTION:

Structure CR		**Geotechnical CR**		**Stream CR**	

LEGEND:

LDS	**Land Drainage Sewer**	**Conc**	**Concrete Pipe**
CS	**Combined Sewer**	**CMP**	**Corrugated Metal Pipe**
SO	**Sanitary Overflow**	**Comp**	**Composite (Concrete & CMP)**
TS	**Treated Sewage**	**WS**	**Wood Stave Pipe**

[1] For larger outfalls where significant deterioration is noted, a detailed inspection will required to document the pipe distress related to station and circumferential location.

Water and Waste Department
Outfall Condition and Maintenance Study
INSPECTION FORM[1]

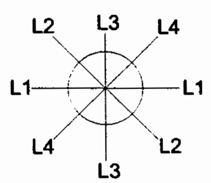
Inspector:		**Date:**
Party Members:		
Temp.	**Weather:**	

Outfall ID No:	**Location:**	**Owner:**
Type: *LDS CS SO TS*	**Stream:**	

Segment No.	LBIS No.	Shape	D_1 or W	D_2 or H	Length	Material
1						
2						
3						

Invert of outfall (m):	**Sag depth (m):**	**Grates:** *Y N*

Deformation (mm)



	Sta.______	Sta.______	Sta._____	Sta._______
L1				
L2				
L3				
L4				

Ice Damage: *Y N*	**Description:**	
Hydraulic restrictions:	1. - *partial collapse of the pipe*	
	2. - *sediment built up in the pipe*	
	3. - *severe restriction - vegetation*	

Geotechnical Features

Bank Height	River Section	Slope	Slump	Erosion	Vegetation	Instrumentation
	Straight Outside Bend Inside Bend	1V:2H 1V:3H 1V:4H 1V:5H	Deep Seated Active Inactive Shallow Hummocky Stable Retrogressive	Toe Scour Undercutting Slope Rills	Mature Trees Scrub Brush Grass	Inclinometer Piezometer

COMMENTS OR DESCRIPTION:

Structure CR		Geotechnical CR		Stream CR	

LEGEND:

LDS	Land Drainage Sewer	Conc	Concrete Pipe
CS	Combined Sewer	CMP	Corrugated Metal Pipe
SO	Sanitary Overflow	Comp	Composite (Concrete & CMP)
TS	Treated Sewage	WS	Wood Stave Pipe

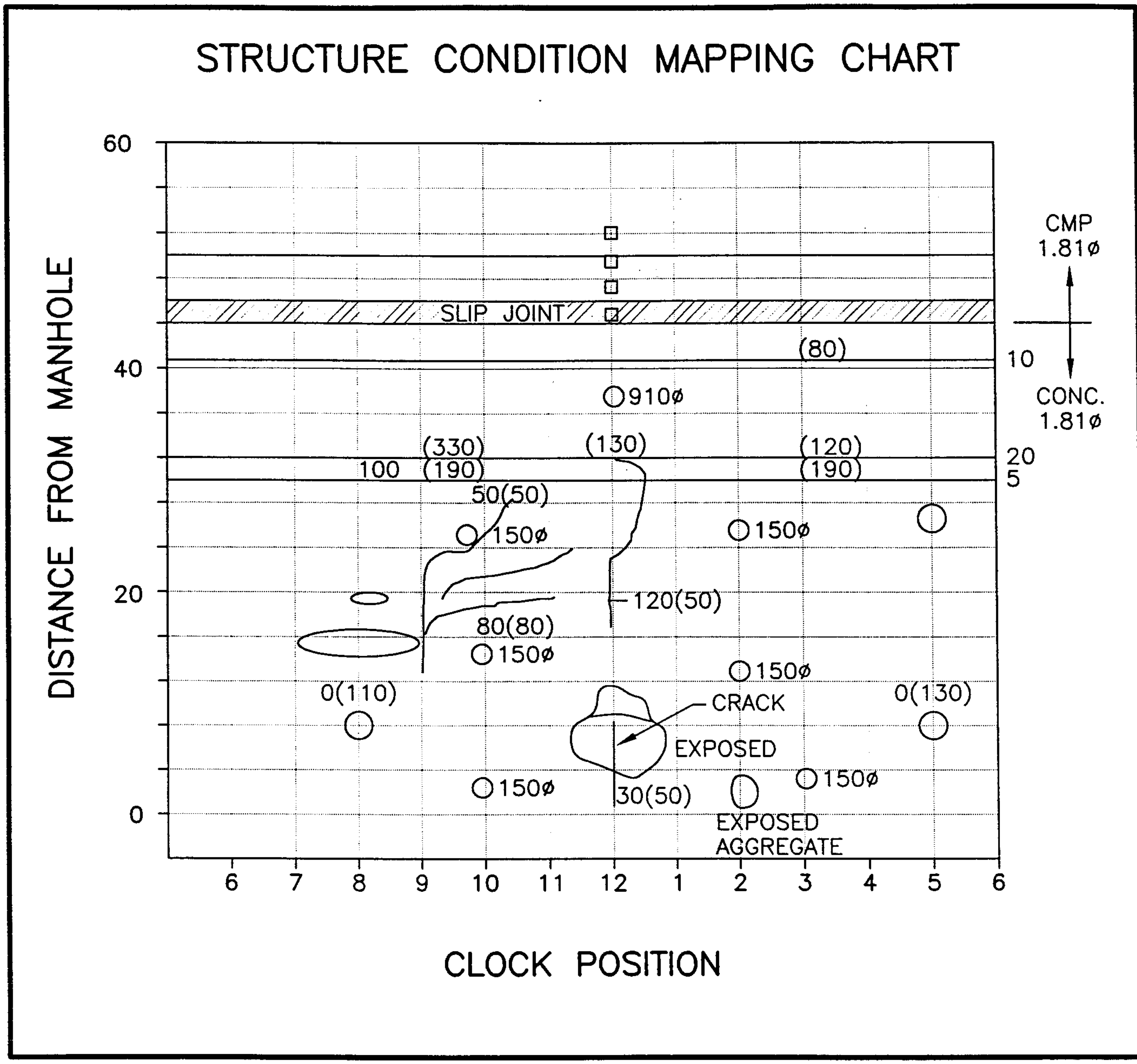
[1] For larger outfalls where significant deterioration is noted, a detailed inspection will required to document the pipe distress related to station and circumferential location.

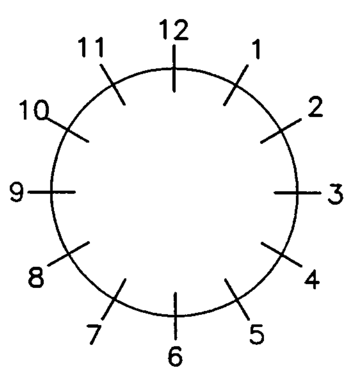
APPENDIX C
Structure Condition Charts

APPENDIX C

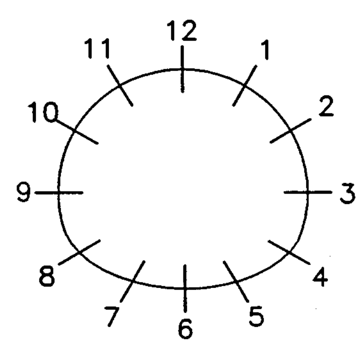
STRUCTURE CONDITION CRACK MAPPING CHARTS

RED RIVER





Clock Reference Looking
DOWNSTREAM



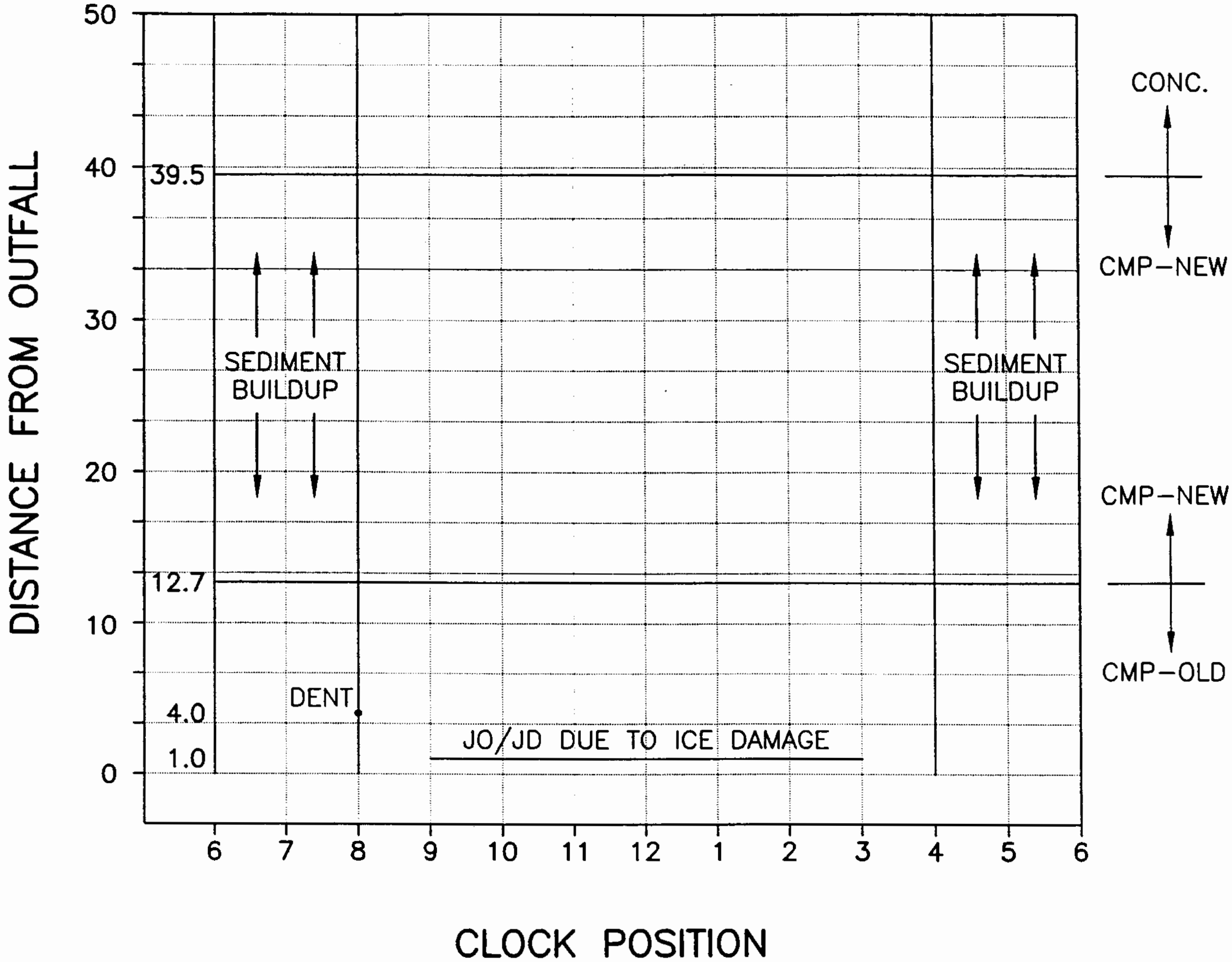
Clock Reference Looking
DOWNSTREAM

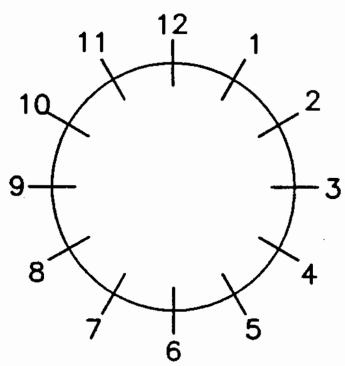
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R83	

KGS FILE NO.: 97-107-12R83

STRUCTURE CONDITION MAPPING CHART





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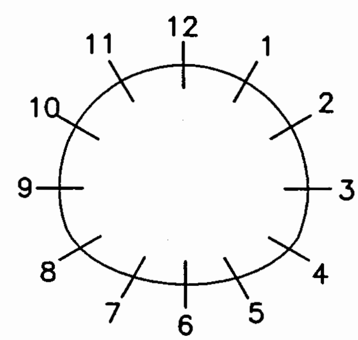


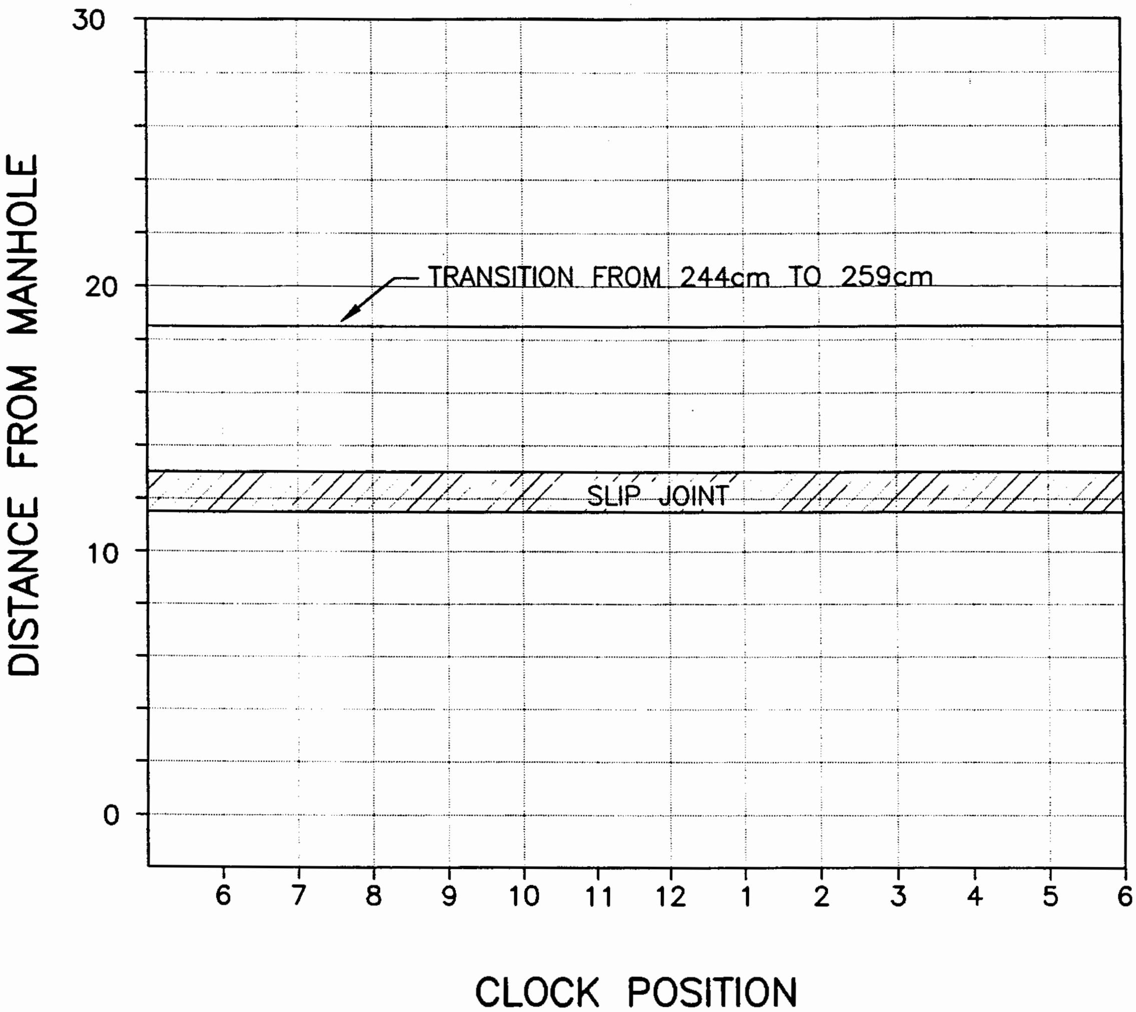
Clock Reference Looking DOWNSTREAM

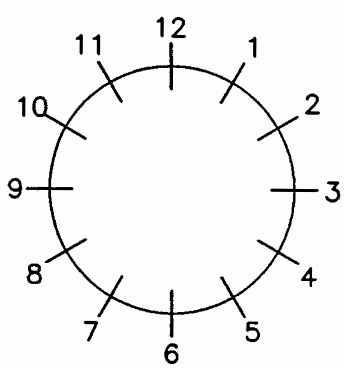
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R87	

KGS FILE NO.: 97–107–12R87

STRUCTURE CONDITION MAPPING CHART





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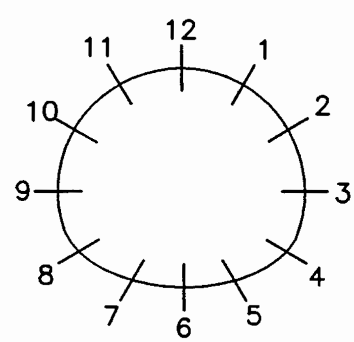
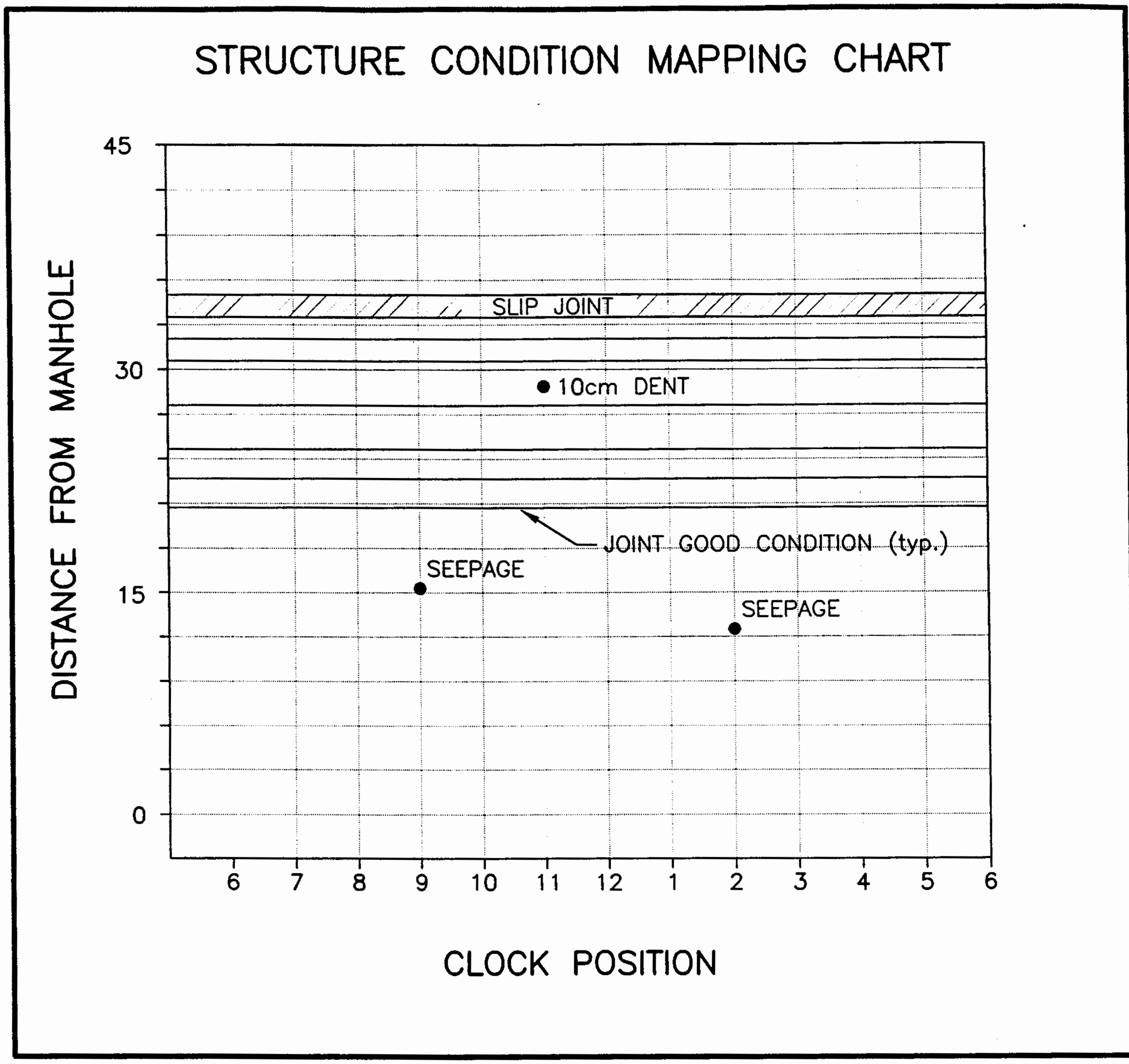
DOWNSTREAM

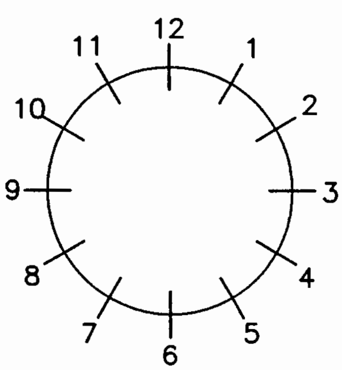


Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R84	





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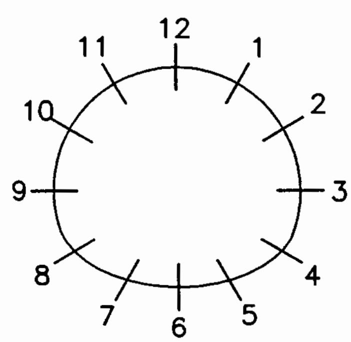


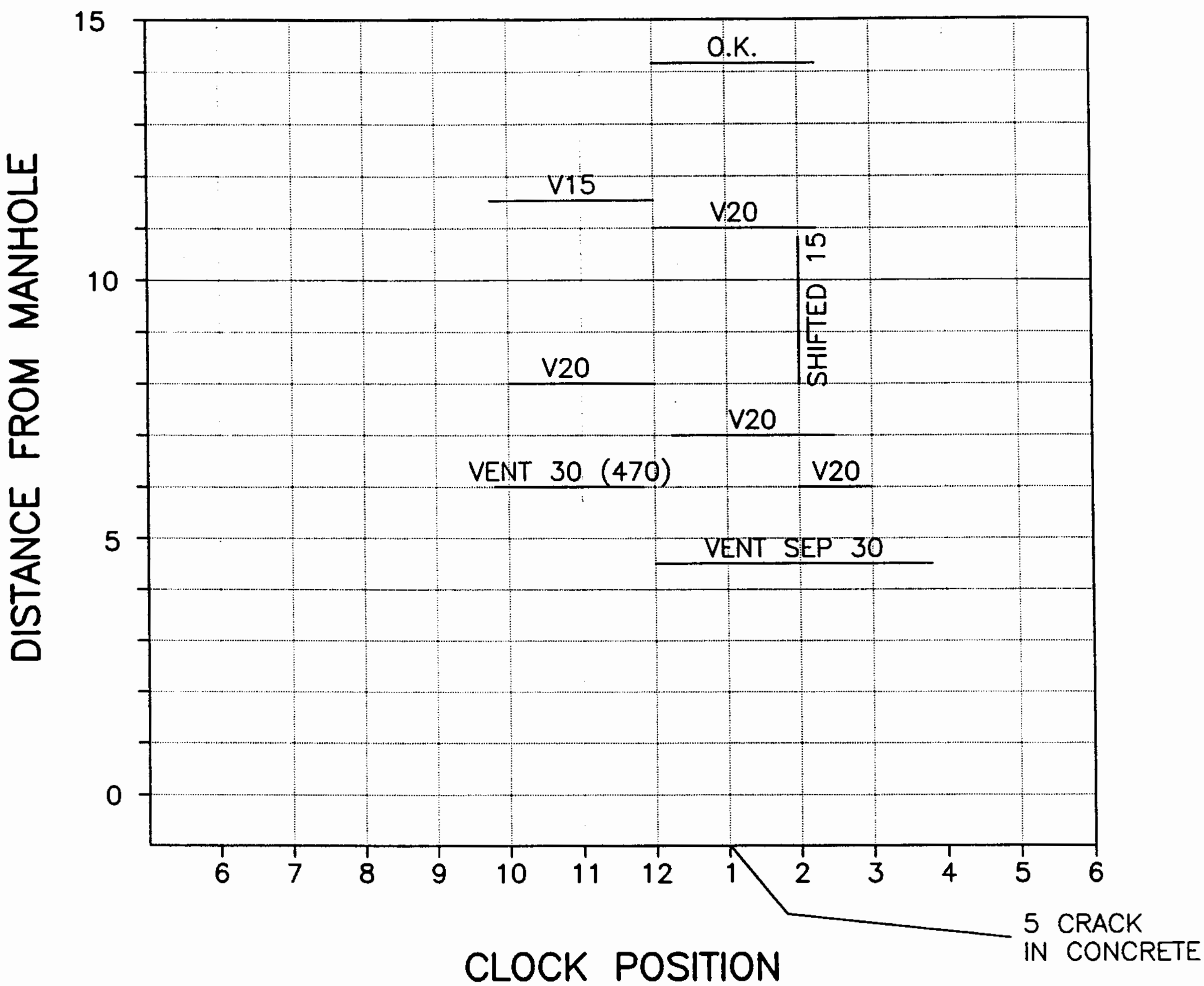
Clock Reference Looking DOWNSTREAM

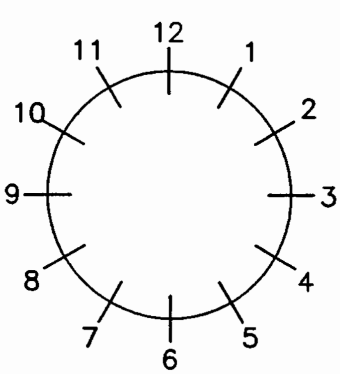
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R88	

KGS FILE NO.: 97-107-12R88

STRUCTURE CONDITION MAPPING CHART





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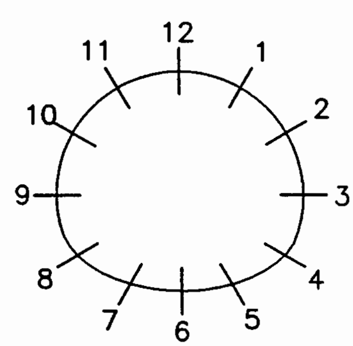

Clock Reference Looking
DOWNSTREAM

LEGEND:

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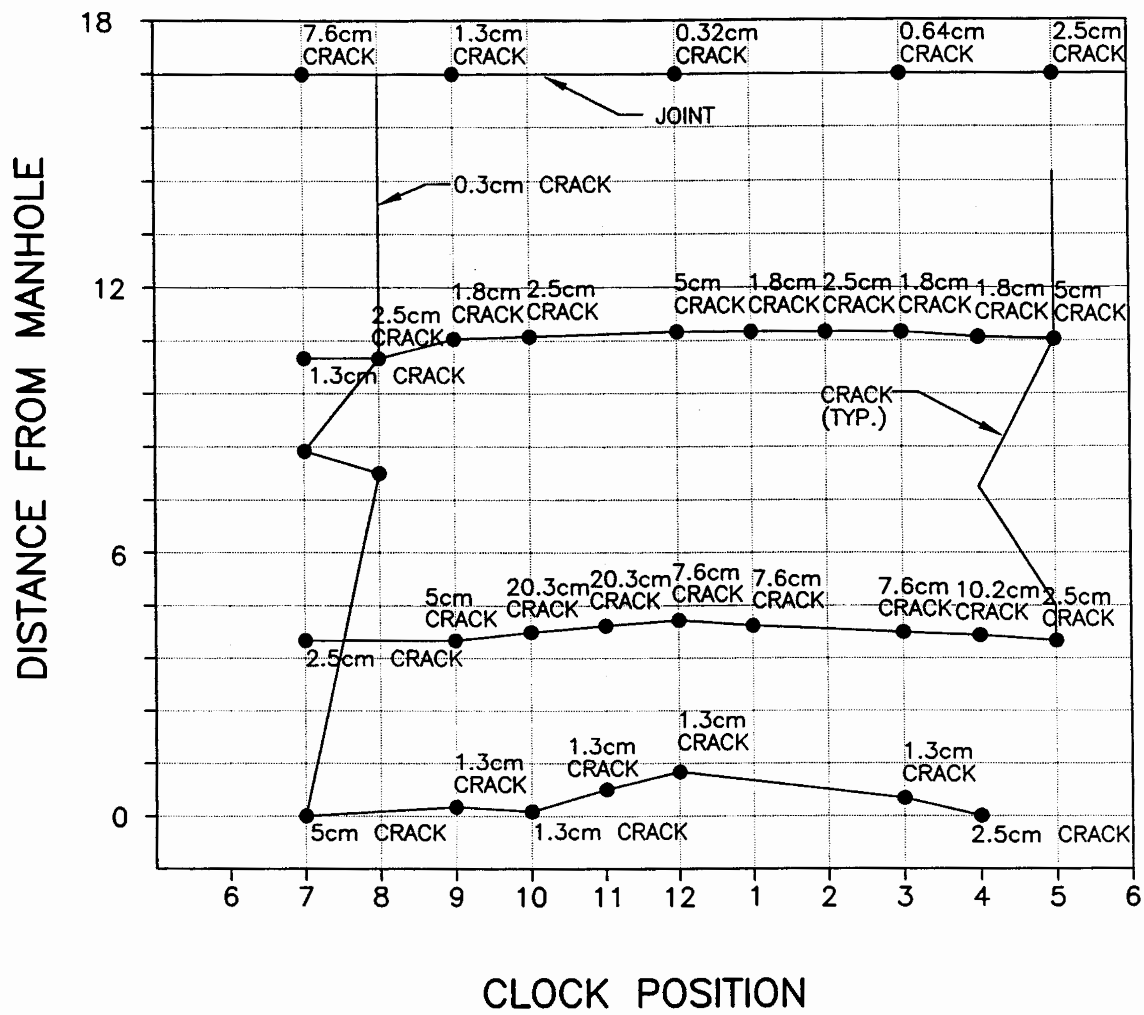
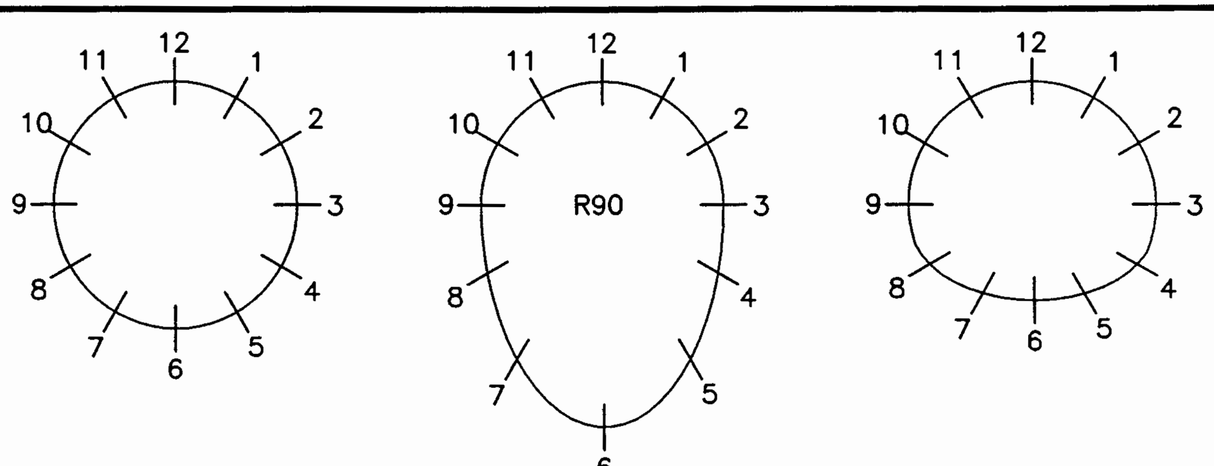
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R88.1	

KGS FILE NO.: 97-107-12R88-1

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM

Clock Reference Looking DOWNSTREAM

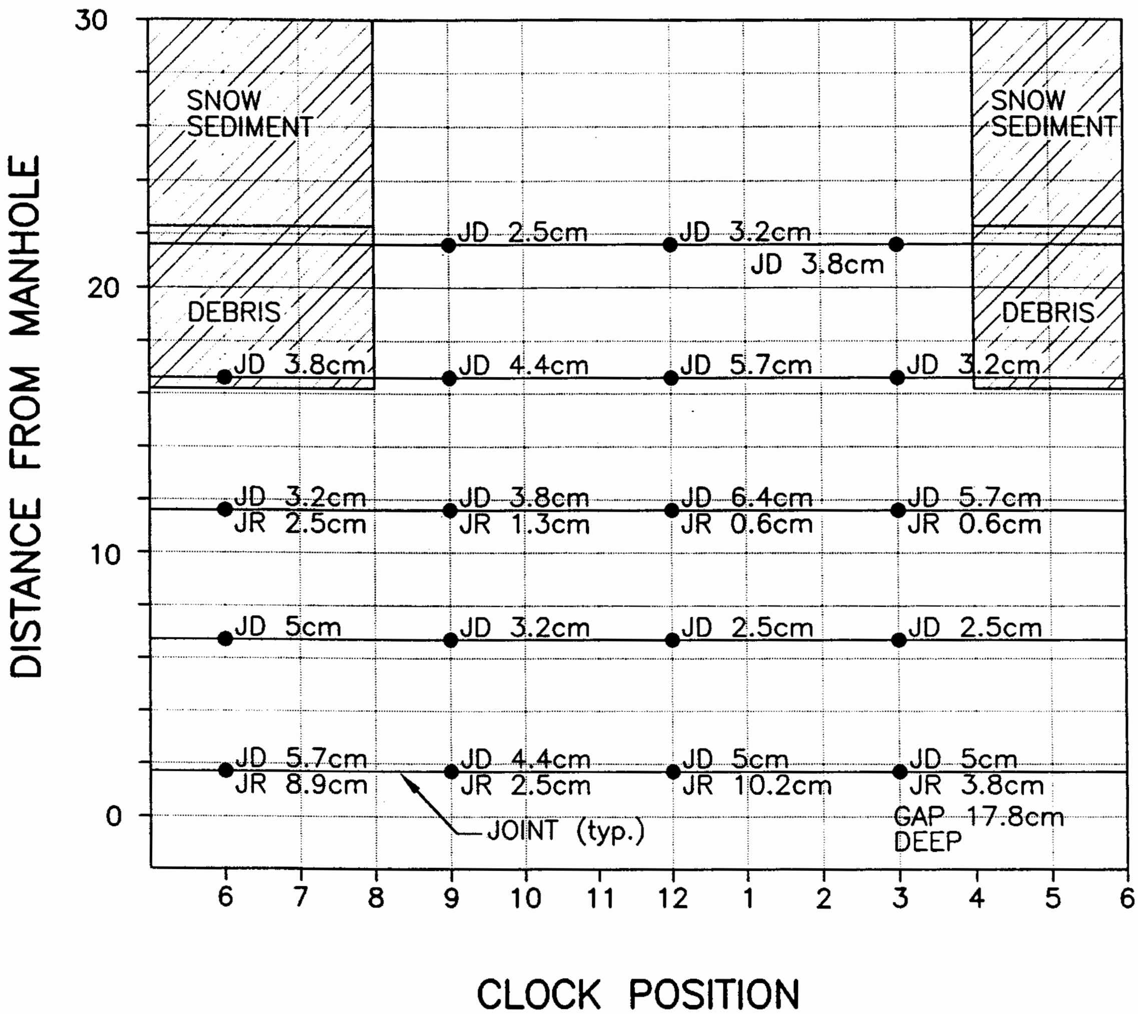
Clock Reference Looking DOWNSTREAM

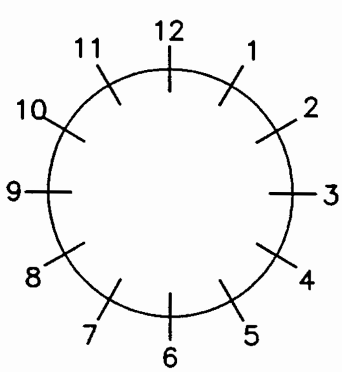
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R90	

KGS FILE NO.: 97-107-12R90

STRUCTURE CONDITION MAPPING CHART





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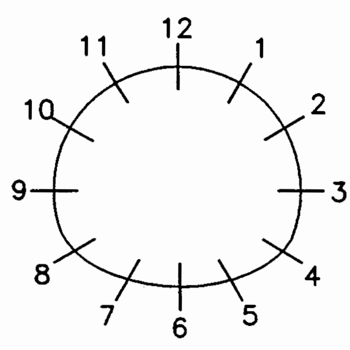

Clock Reference Looking
DOWNSTREAM

LEGEND:

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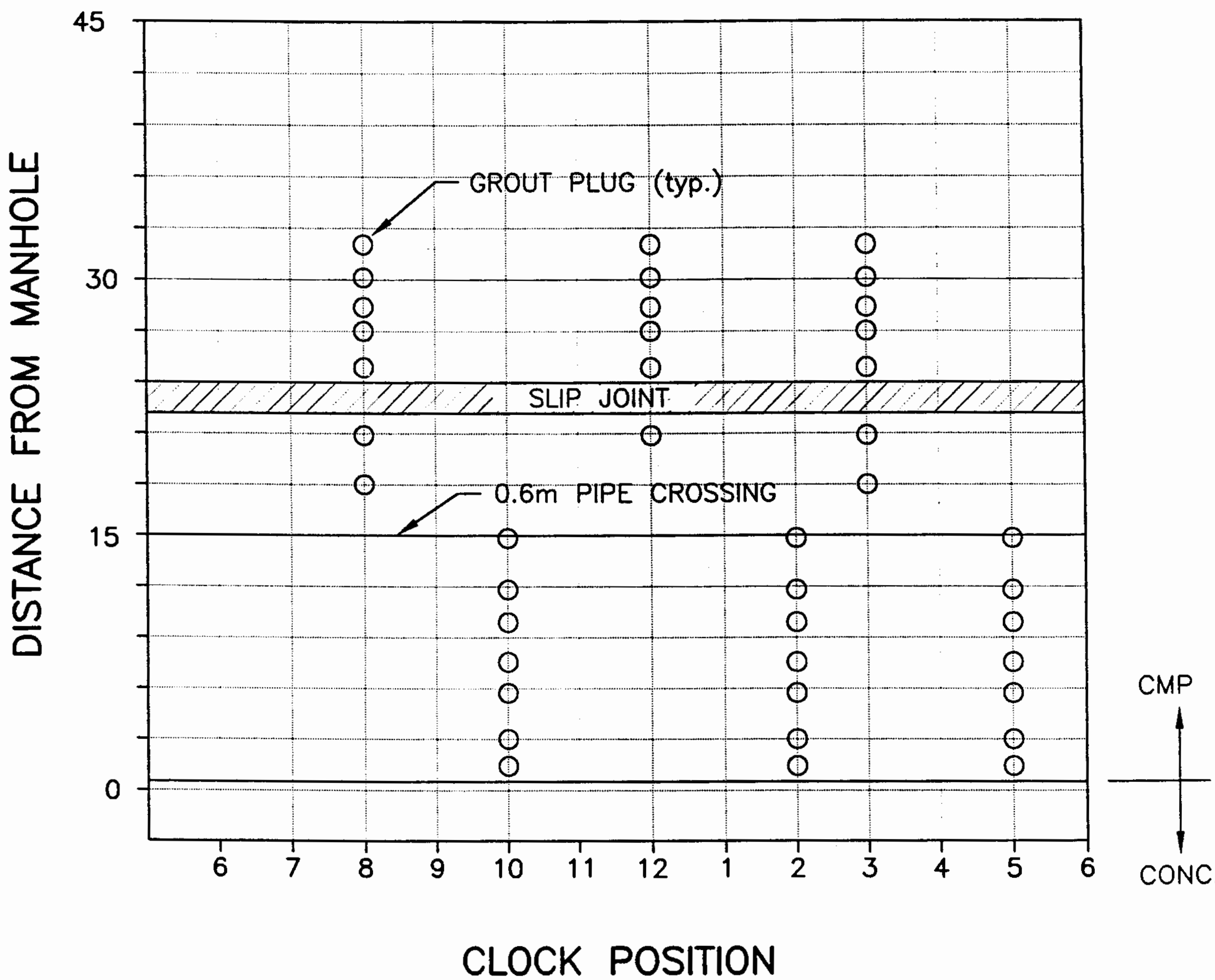
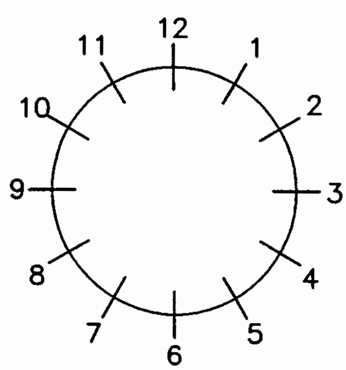
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R91	

KGS FILE NO.: 97-107-12R91

STRUCTURE CONDITION MAPPING CHART





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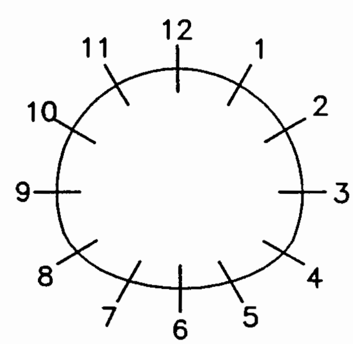

Clock Reference Looking
DOWNSTREAM

LEGEND:

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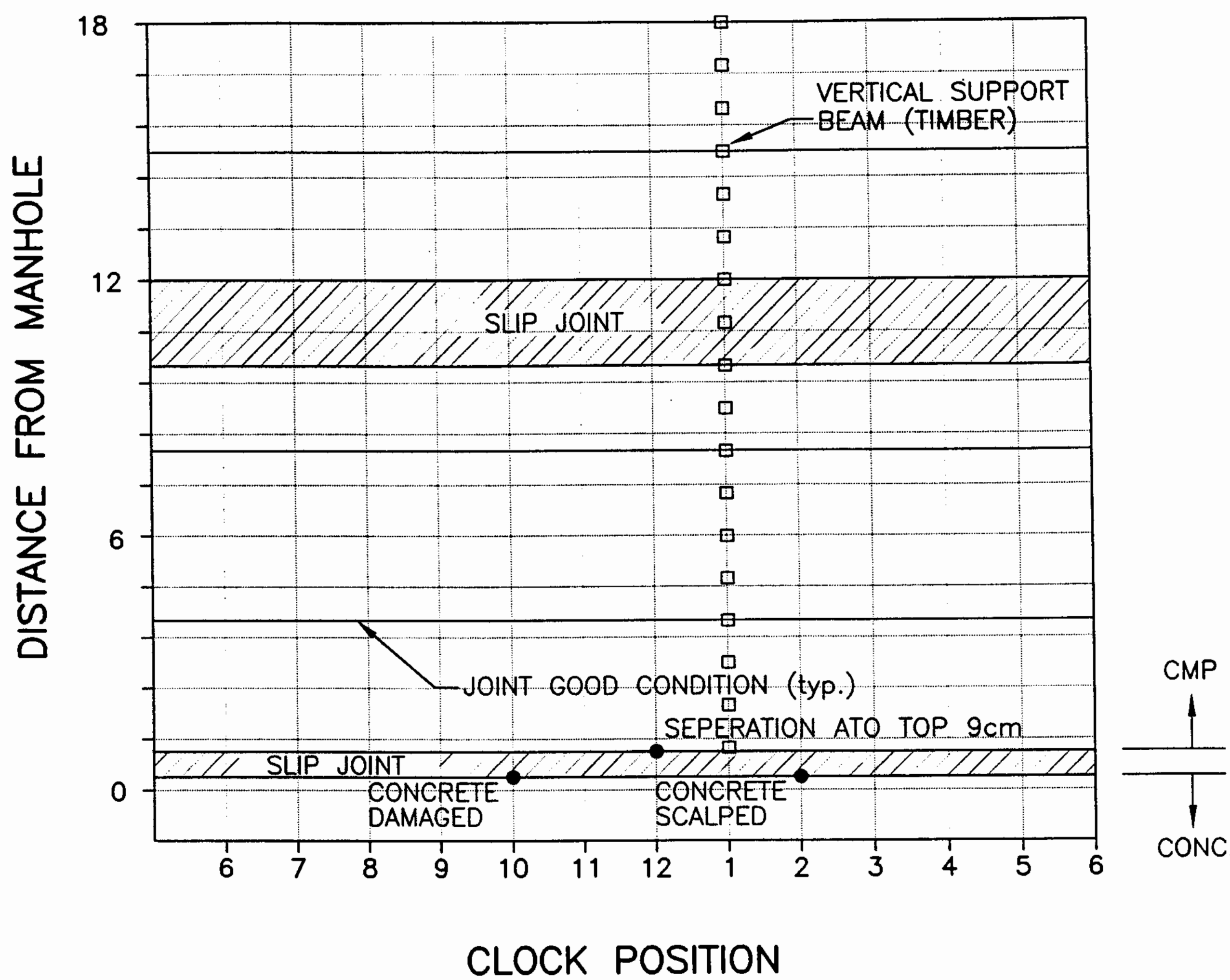
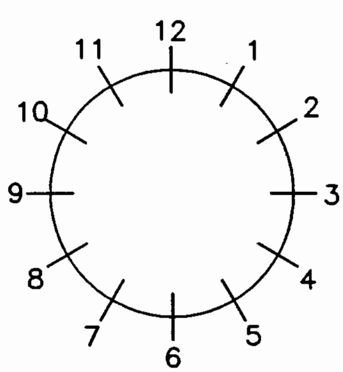
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R94	

KGS FILE NO.: 97-107-12R94

STRUCTURE CONDITION MAPPING CHART





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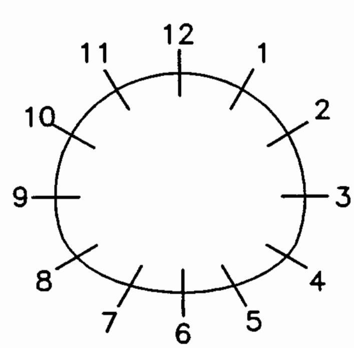

Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
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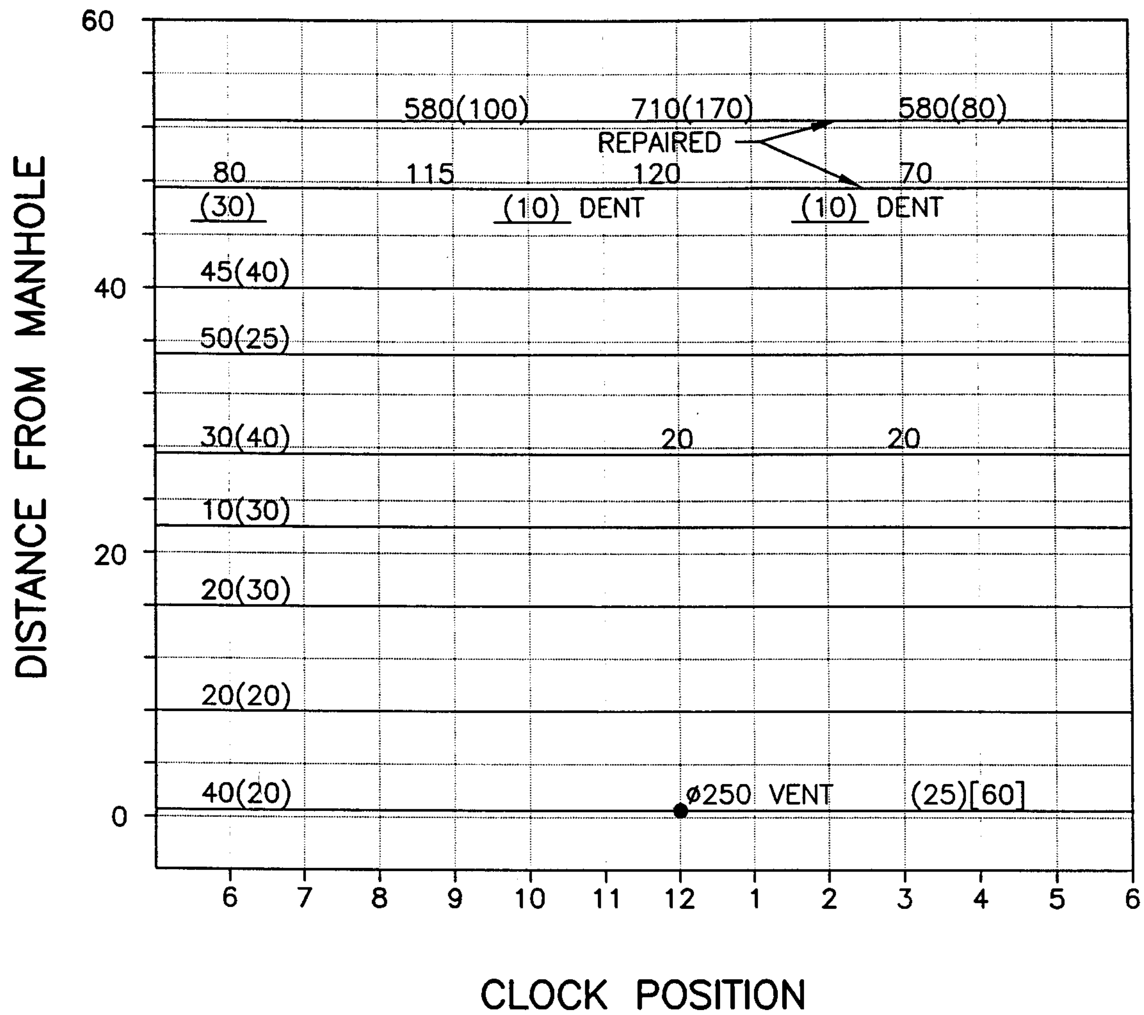
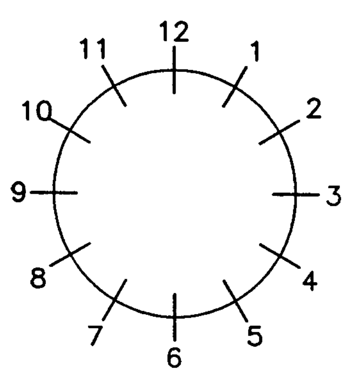
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R95	

STRUCTURE CONDITION MAPPING CHART





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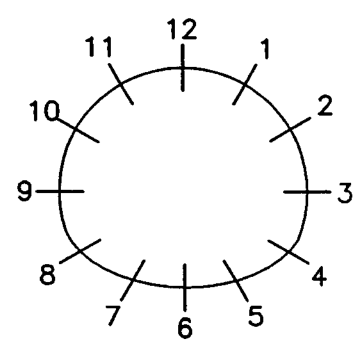
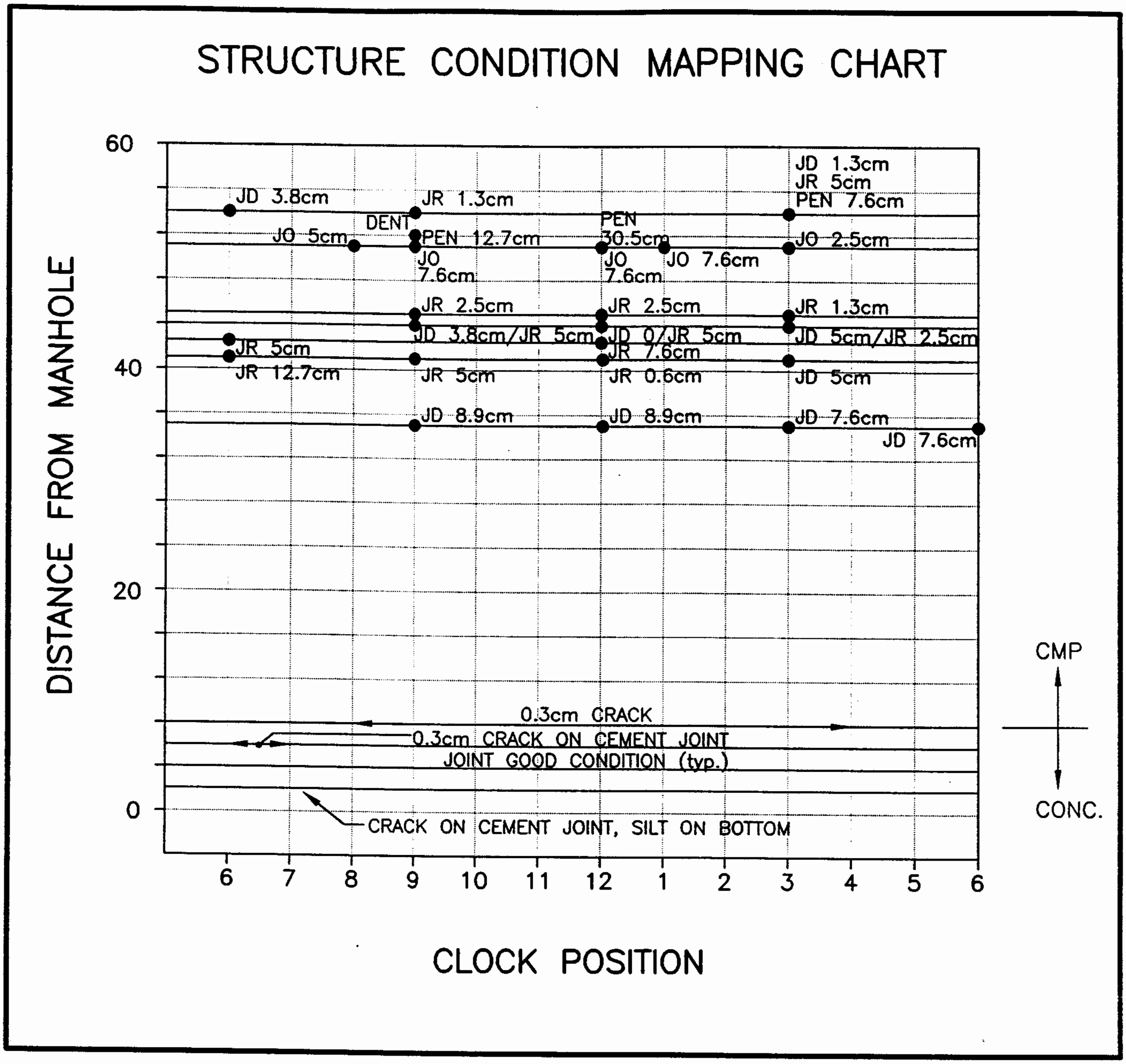


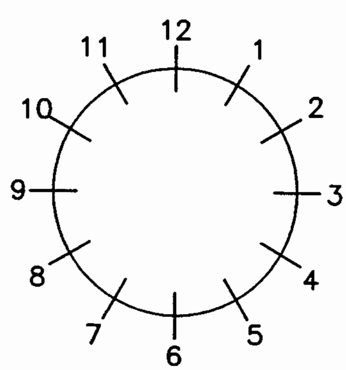
Clock Reference Looking DOWNSTREAM

LEGEND:

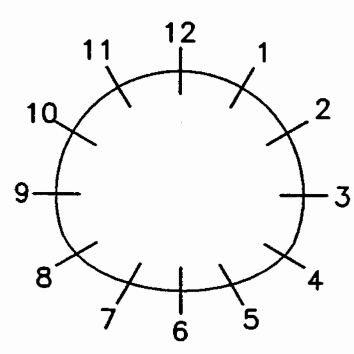
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R98	

KGS FILE NO.: 97-107-12R98





Clock Reference Looking DOWNSTREAM



Clock Reference Looking DOWNSTREAM

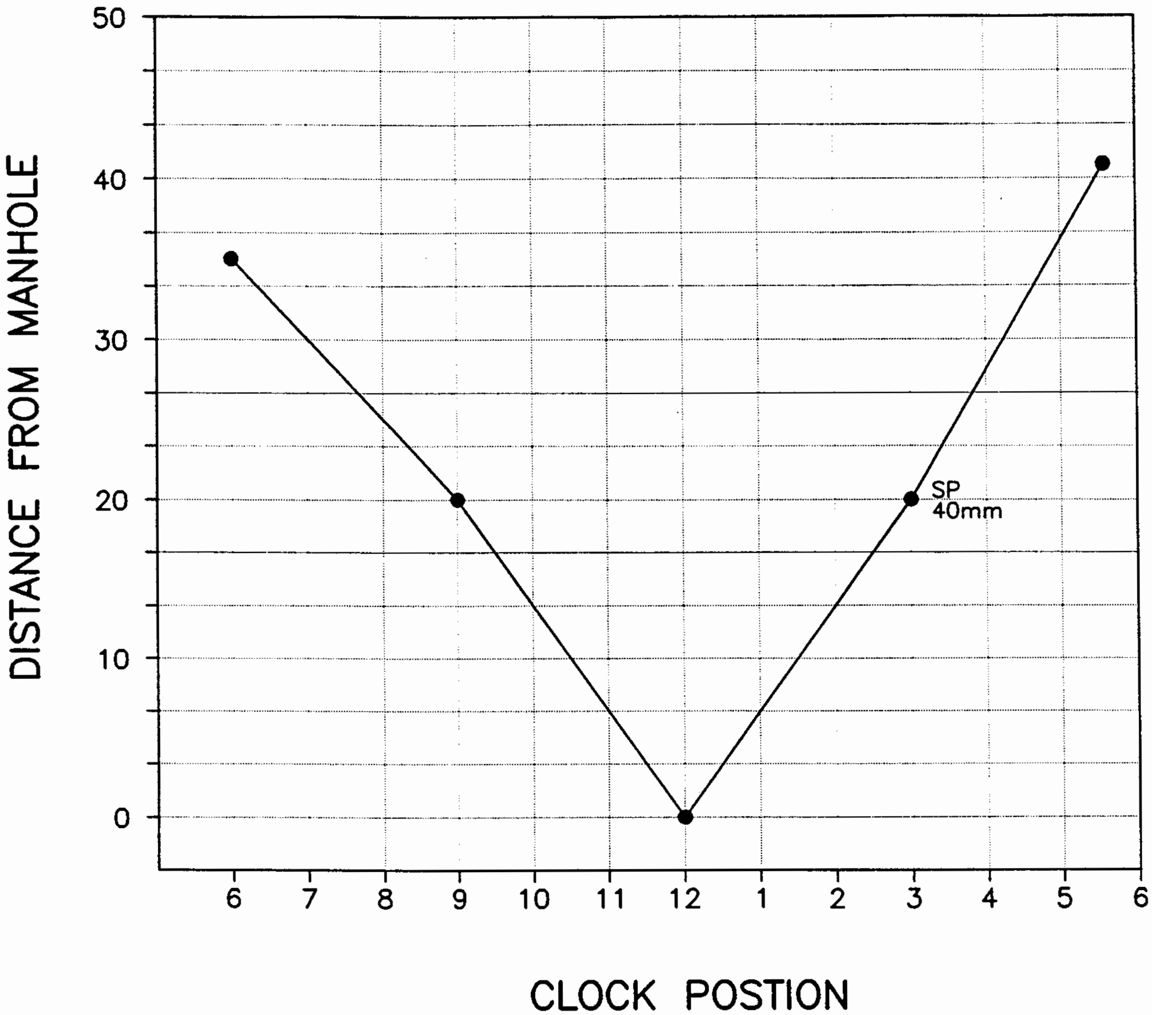
LEGEND:

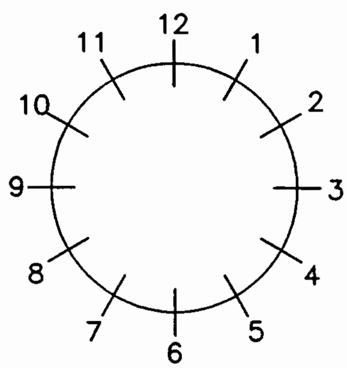
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R103	

KGS FILE NO.: 97-107-12R103

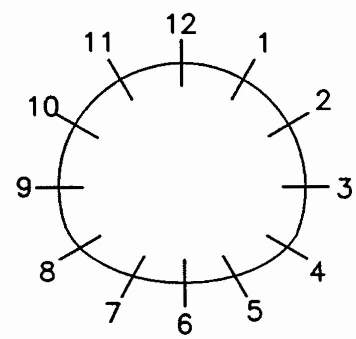
ASSINIBOINE RIVER

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



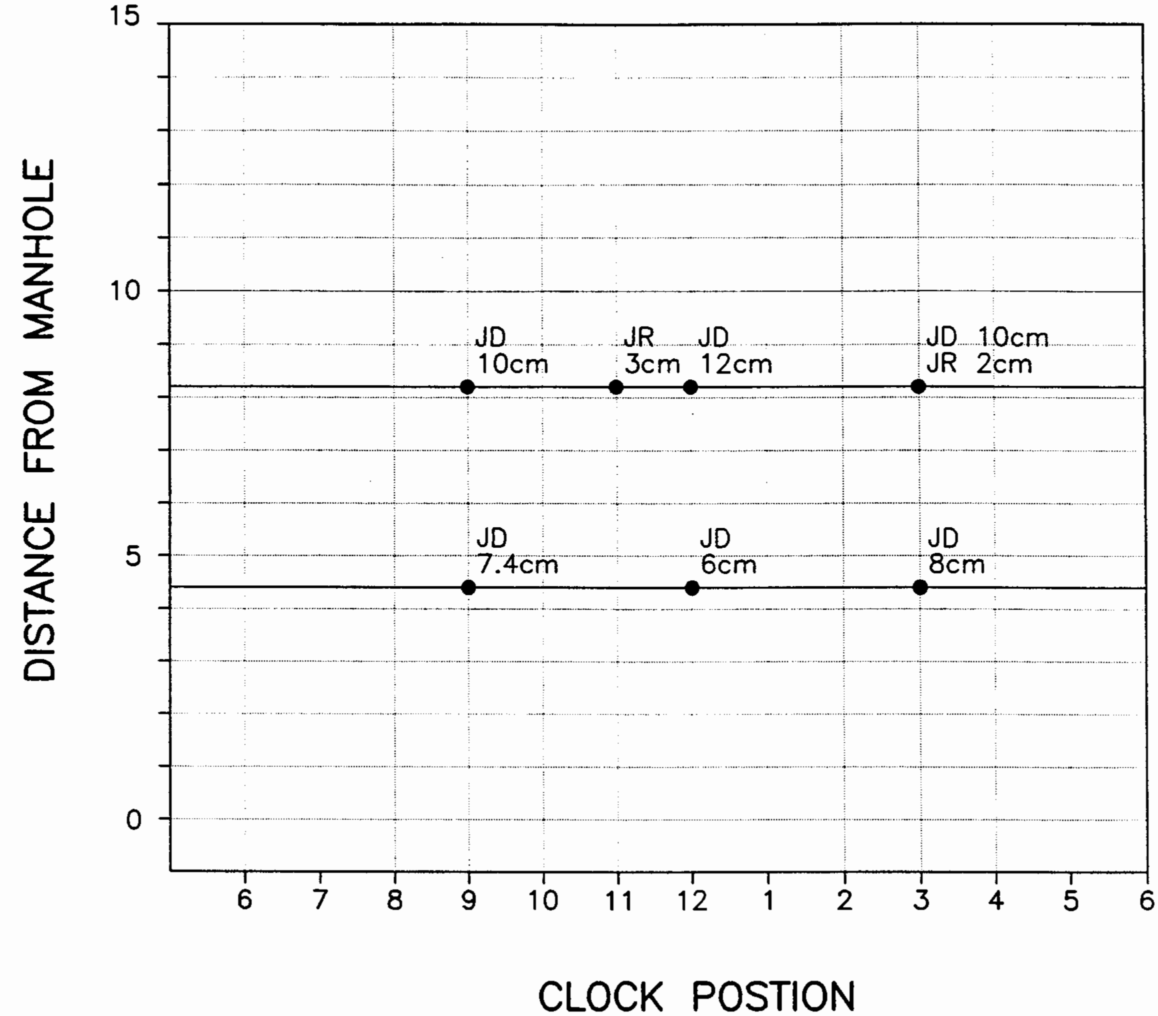
Clock Reference Looking
DOWNSTREAM

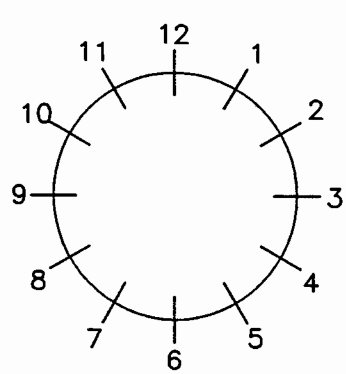
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A1	

KGS FILE NO.: 97-107-12A1

STRUCTURE CONDITION MAPPING CHART





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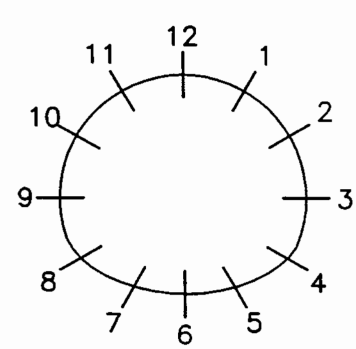


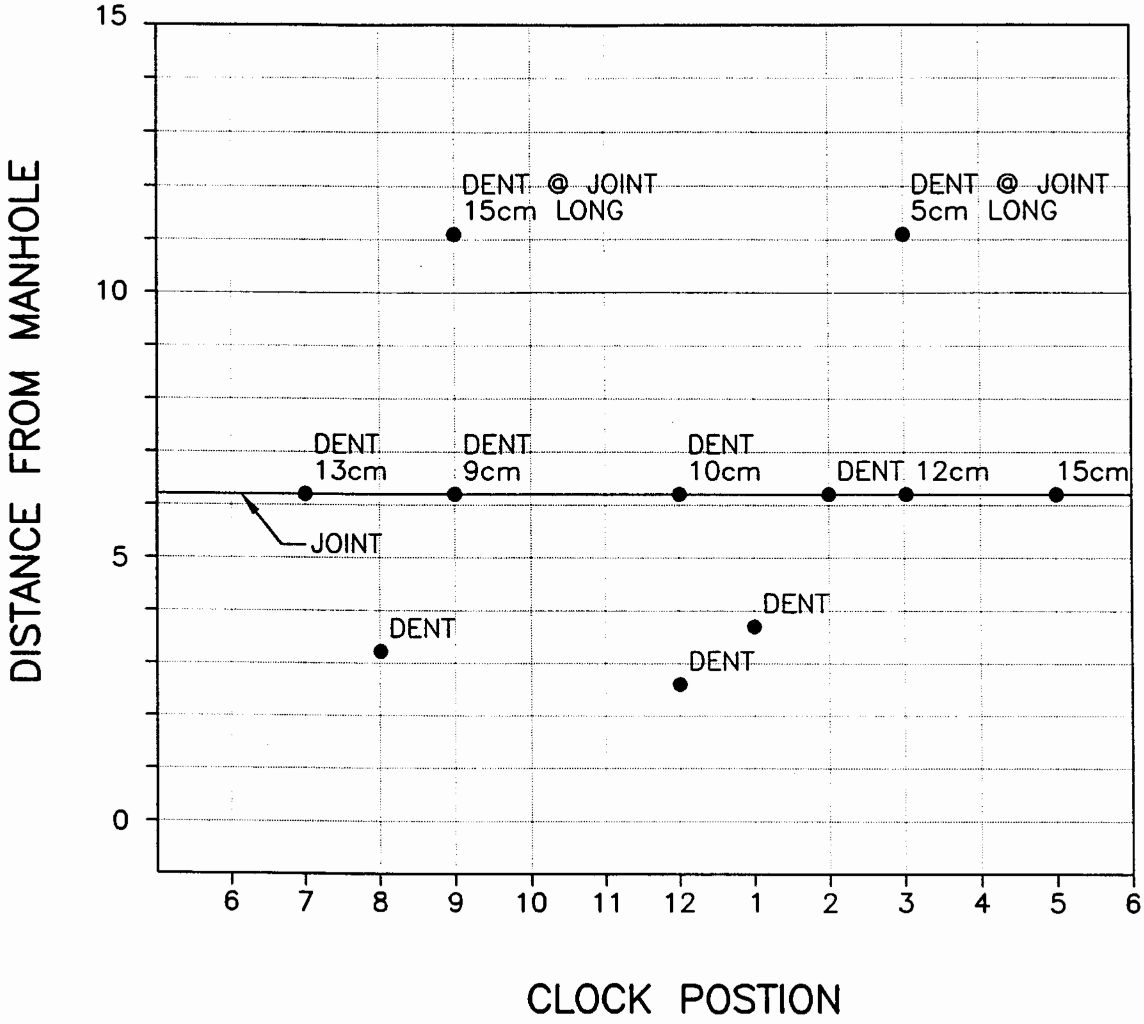
Clock Reference Looking DOWNSTREAM

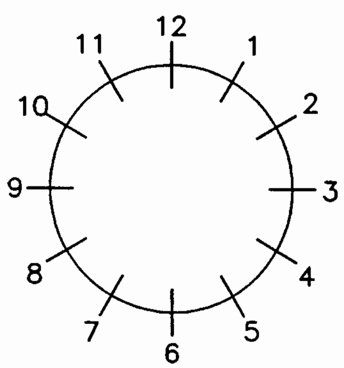
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A2	

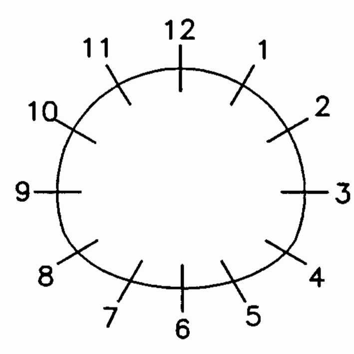
KGS FILE NO.: 97-107-12A2

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



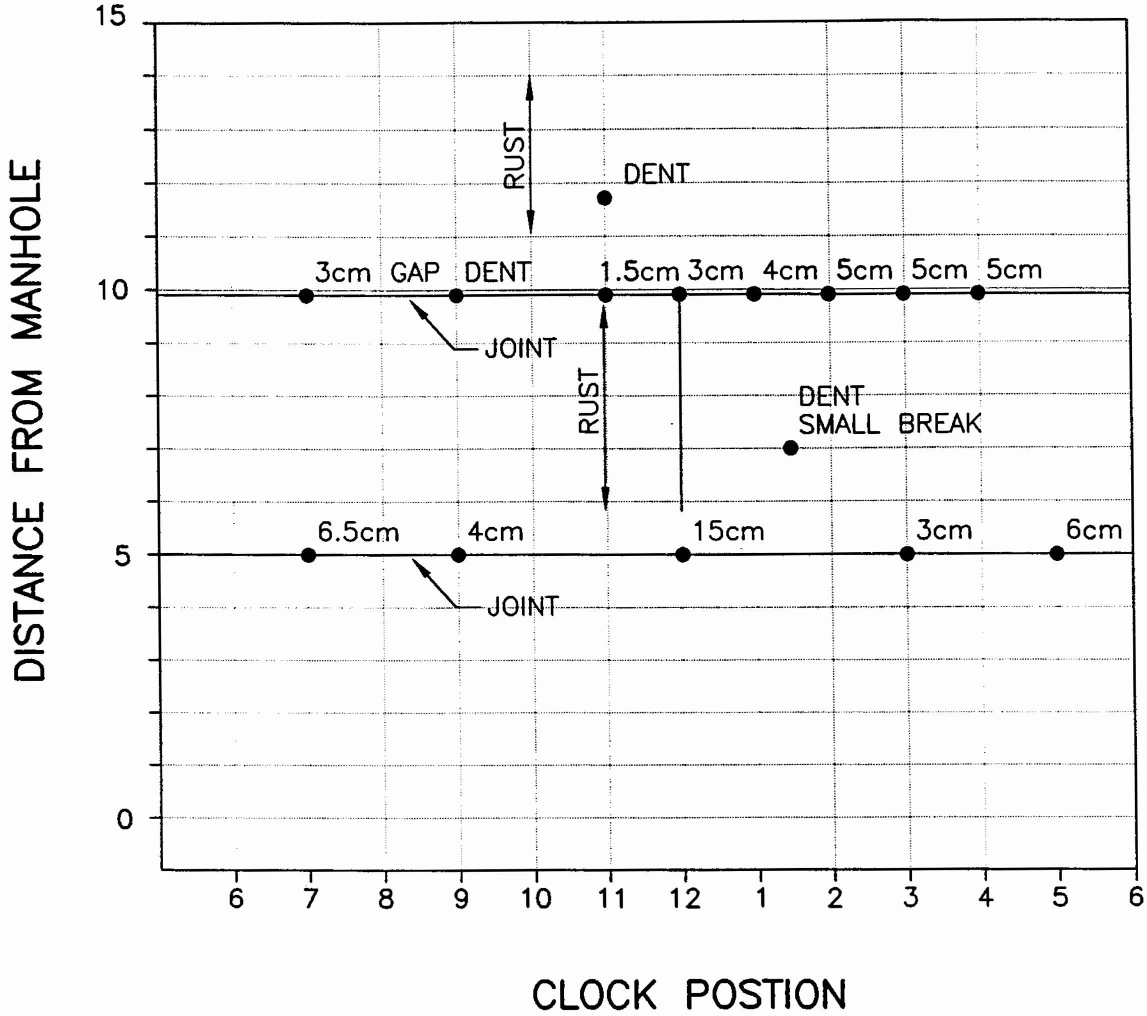
Clock Reference Looking DOWNSTREAM

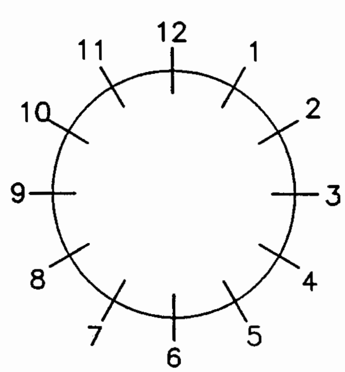
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	$A3_1$	

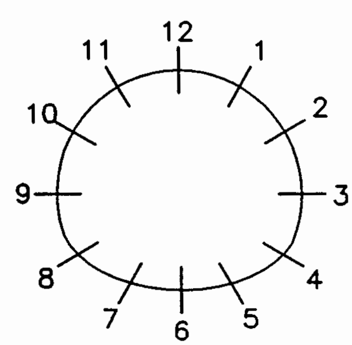
KGS FILE NO.: 97-107-12A3-1

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



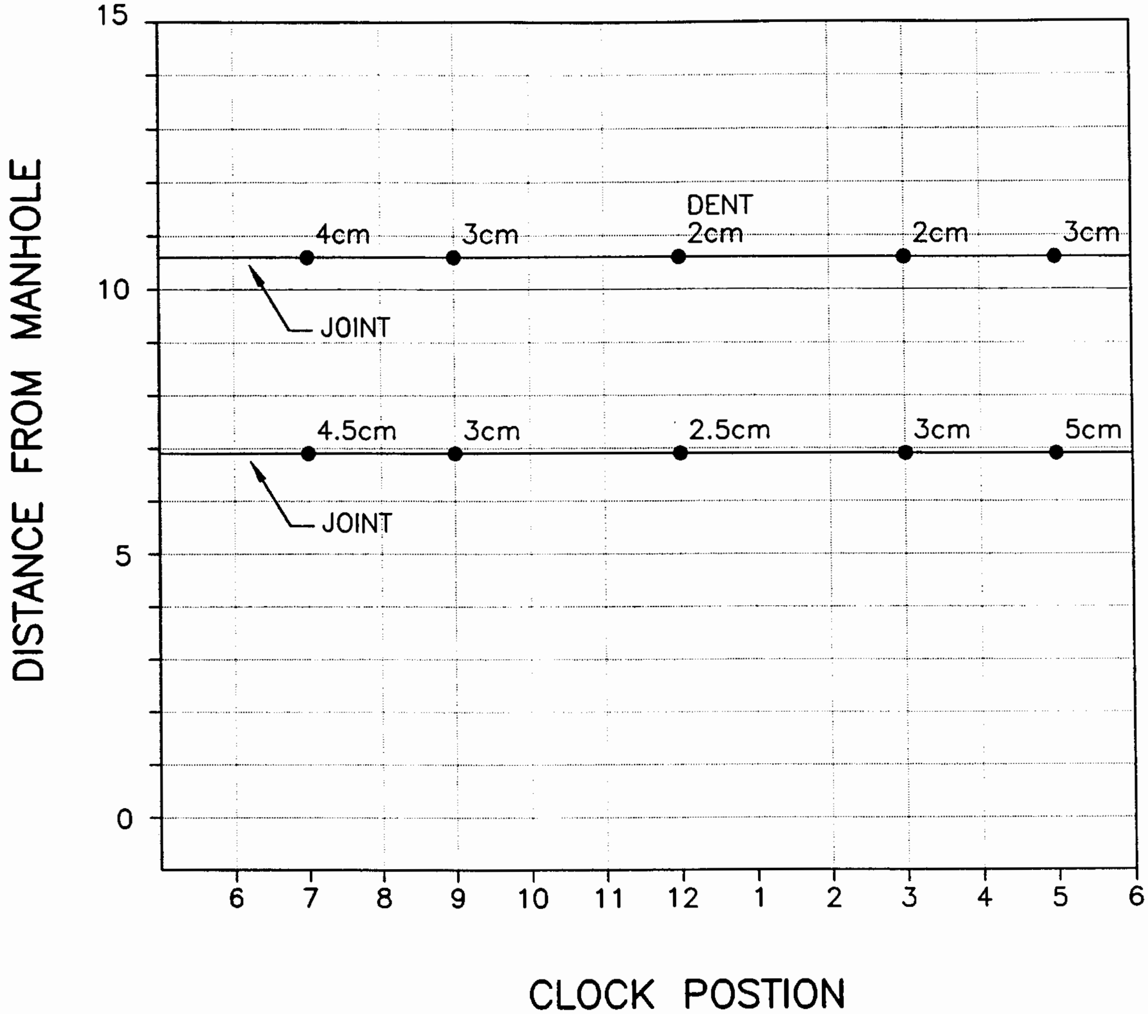
Clock Reference Looking
DOWNSTREAM

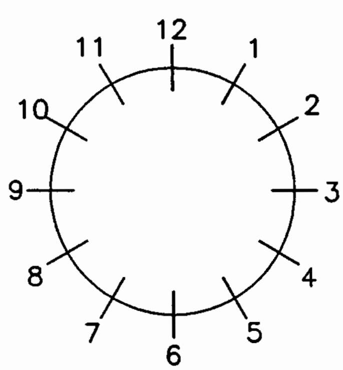
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	$A3_2$	

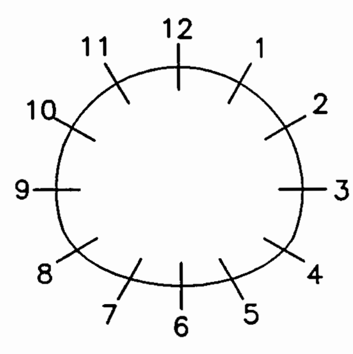
KGS FILE NO.: 97-107-120A3-2

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



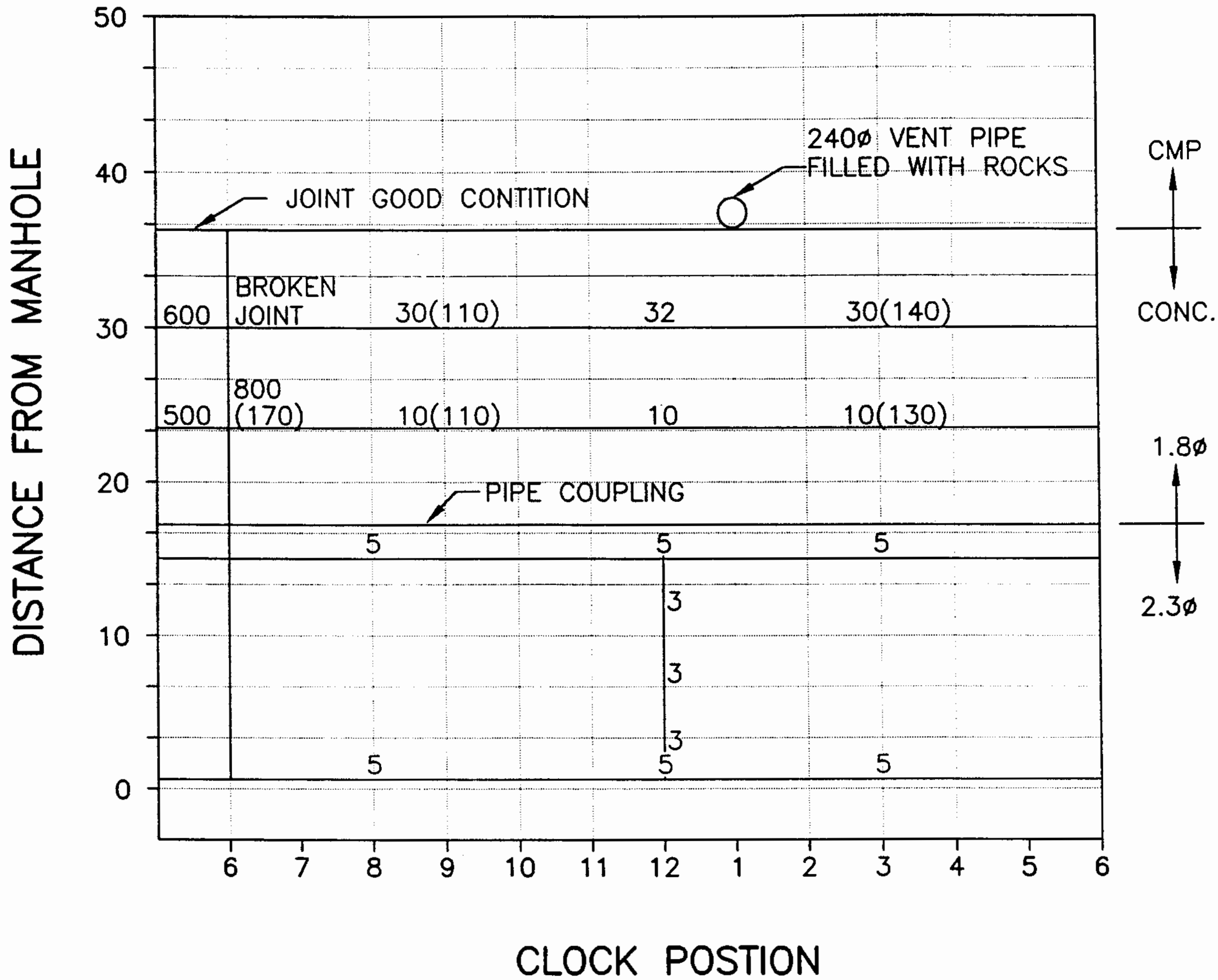
Clock Reference Looking
DOWNSTREAM

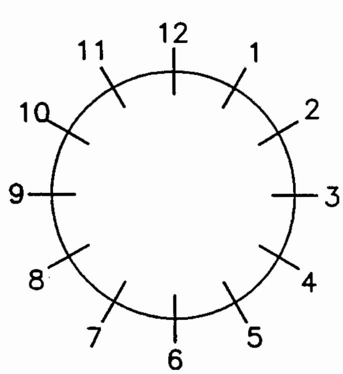
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	$A5_1$	

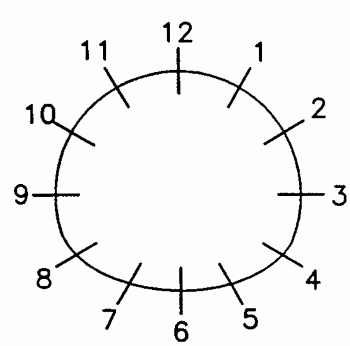
KGS FILE NO.: 97-107-120A5-1

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM

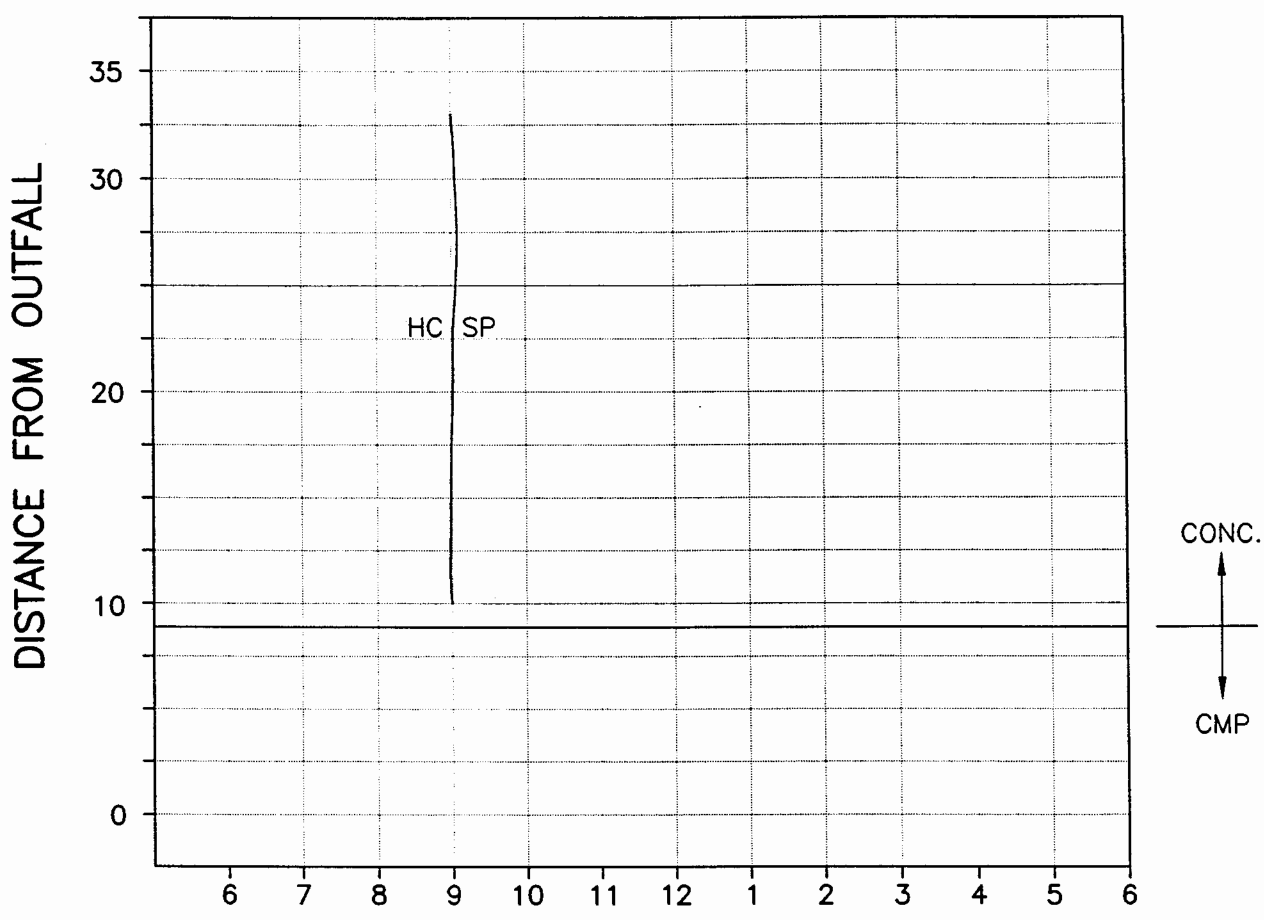


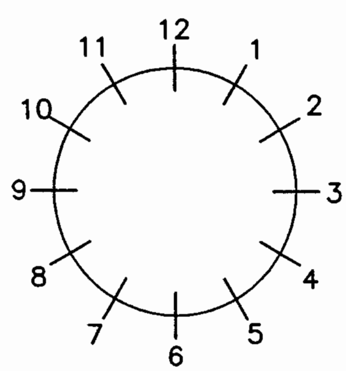
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A10	

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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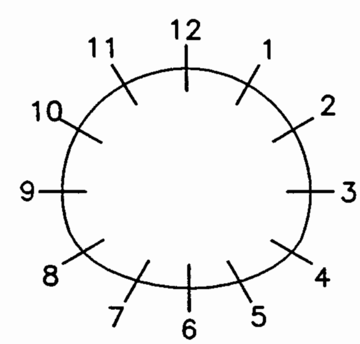


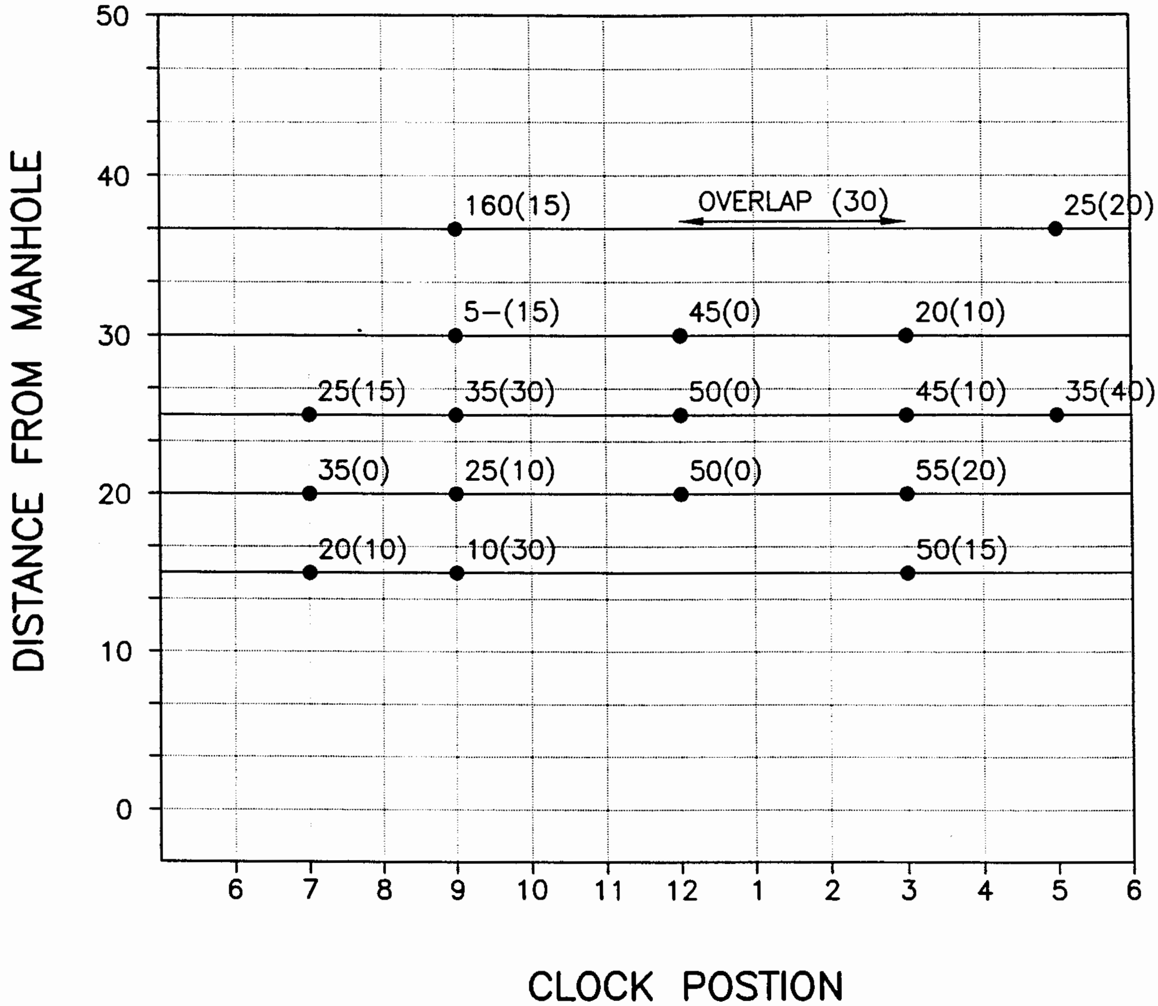
Clock Reference Looking
DOWNSTREAM

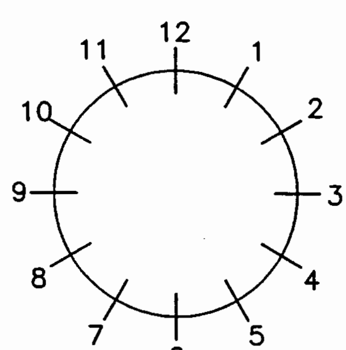
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A16.1	

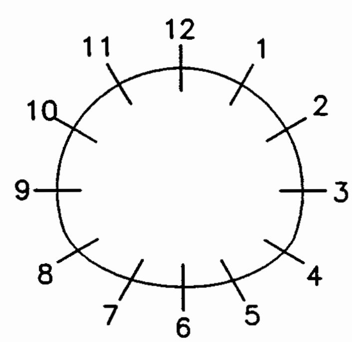
KGS FILE NO.: 97-107-12A16-1

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



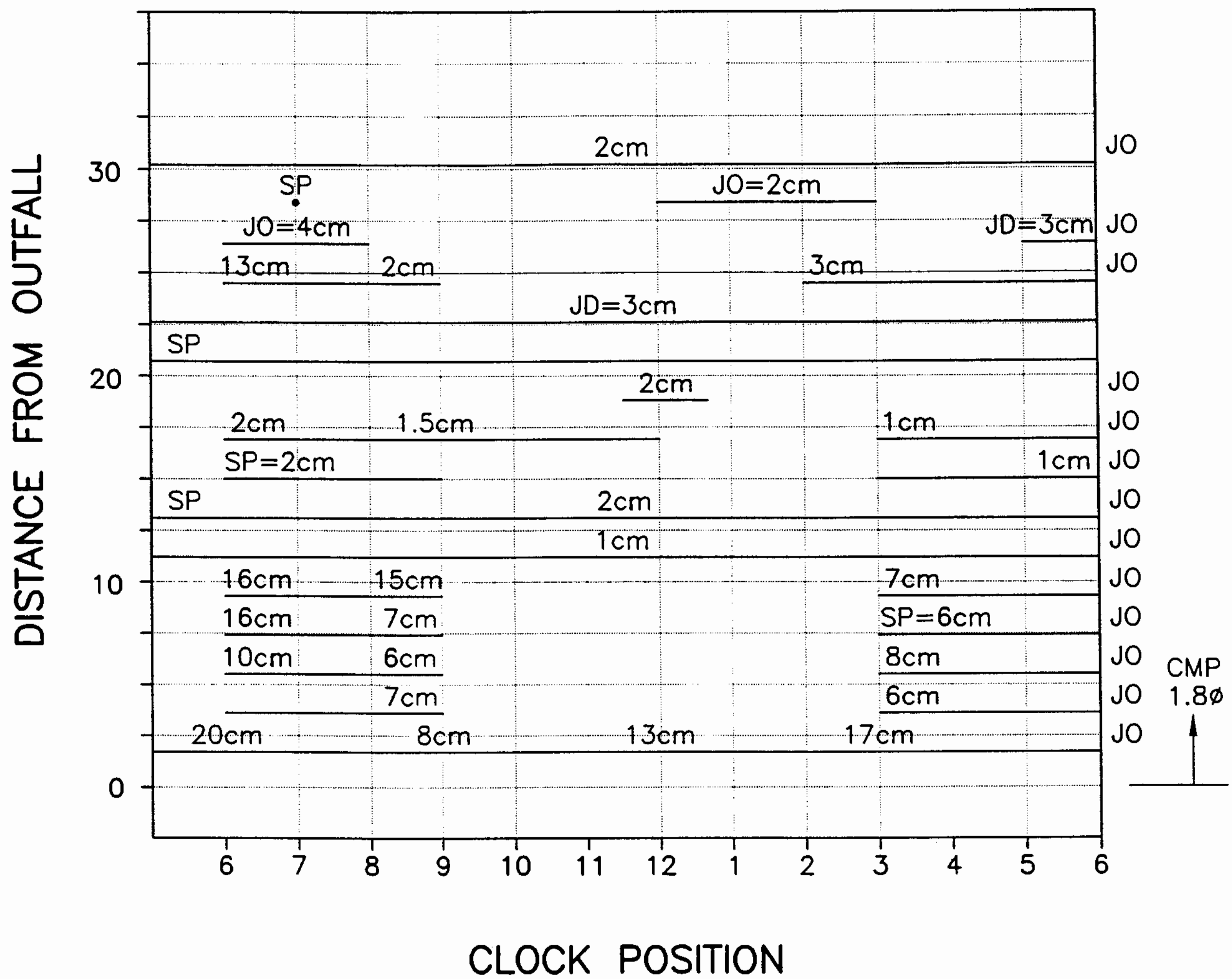
Clock Reference Looking DOWNSTREAM

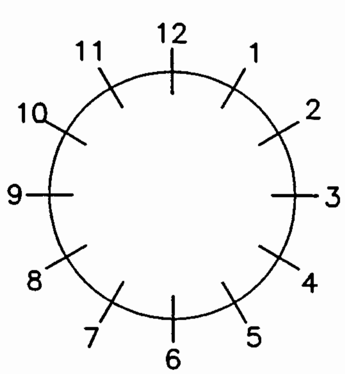
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A18	

KGS FILE NO.: 97-107-12A18

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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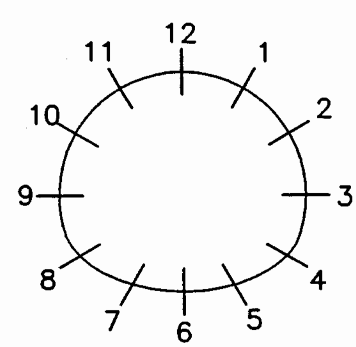


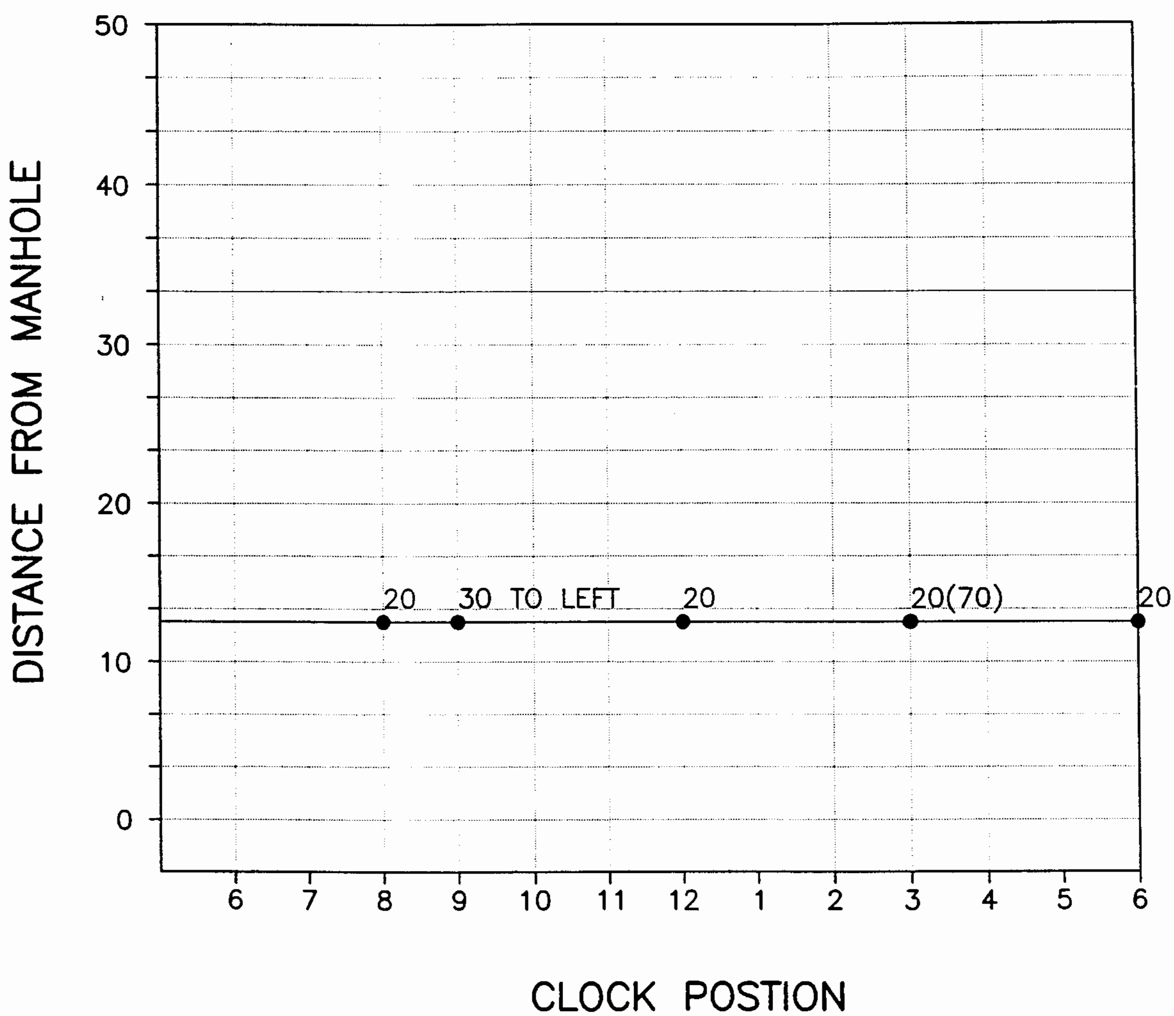
Clock Reference Looking
DOWNSTREAM

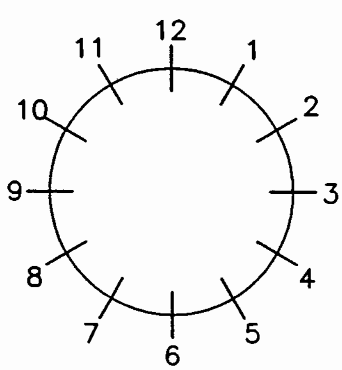
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A19	

KGS FILE NO.: 97-107-12A19

STRUCTURE CONDITION MAPPING CHART





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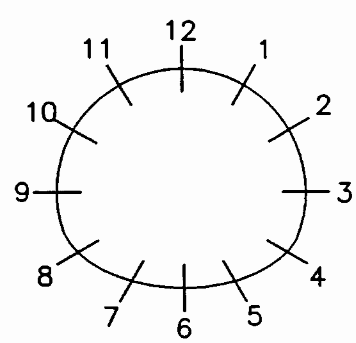


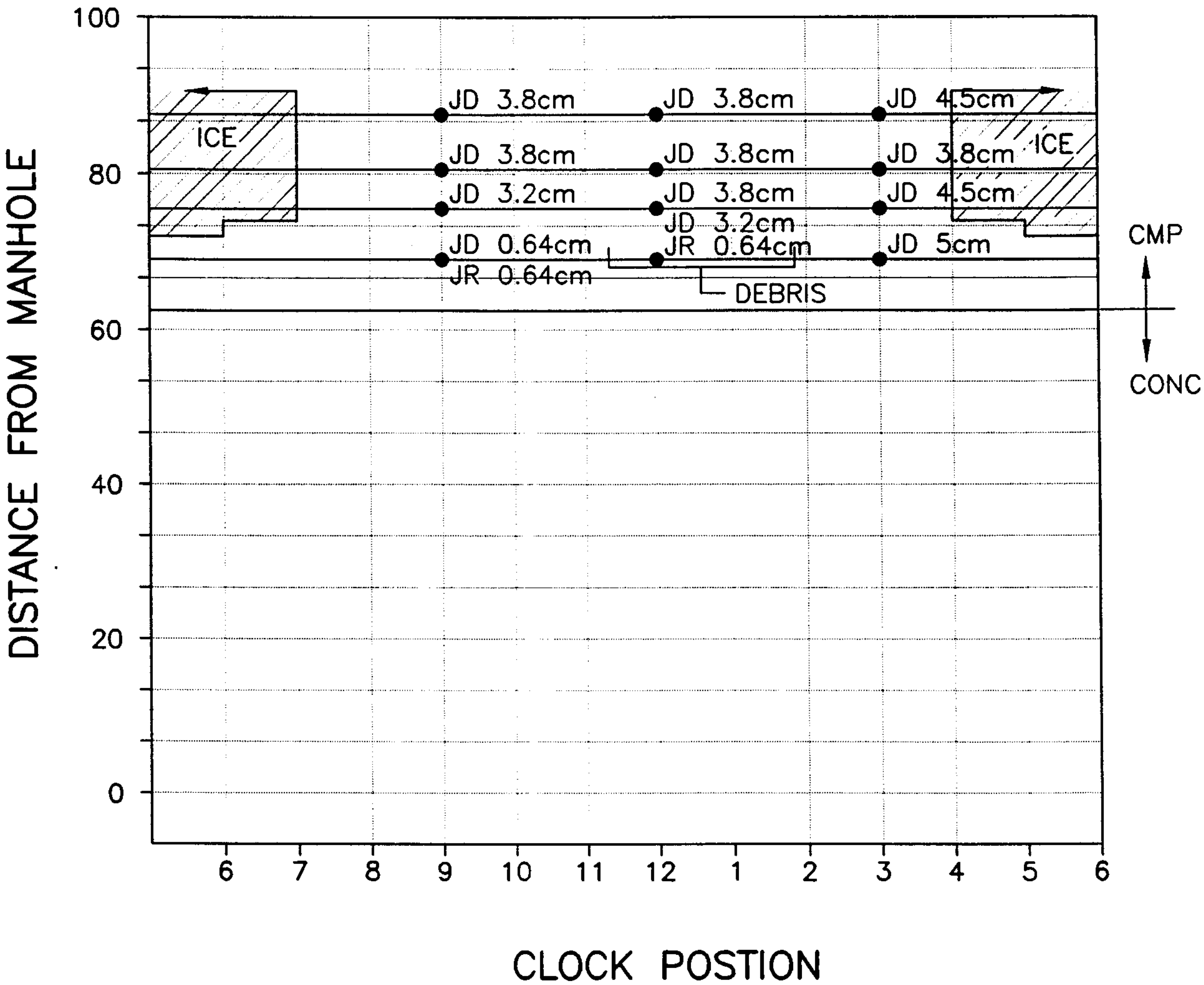
Clock Reference Looking DOWNSTREAM

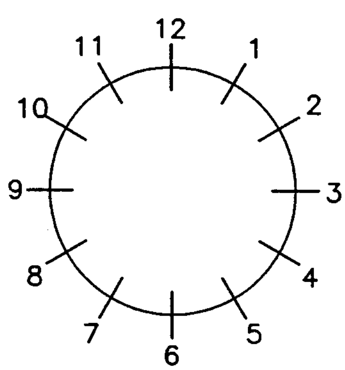
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A35	

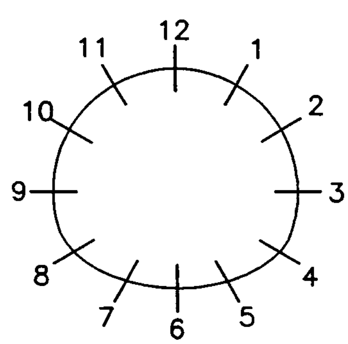
KGS FILE NO.: 97-107-12A35

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



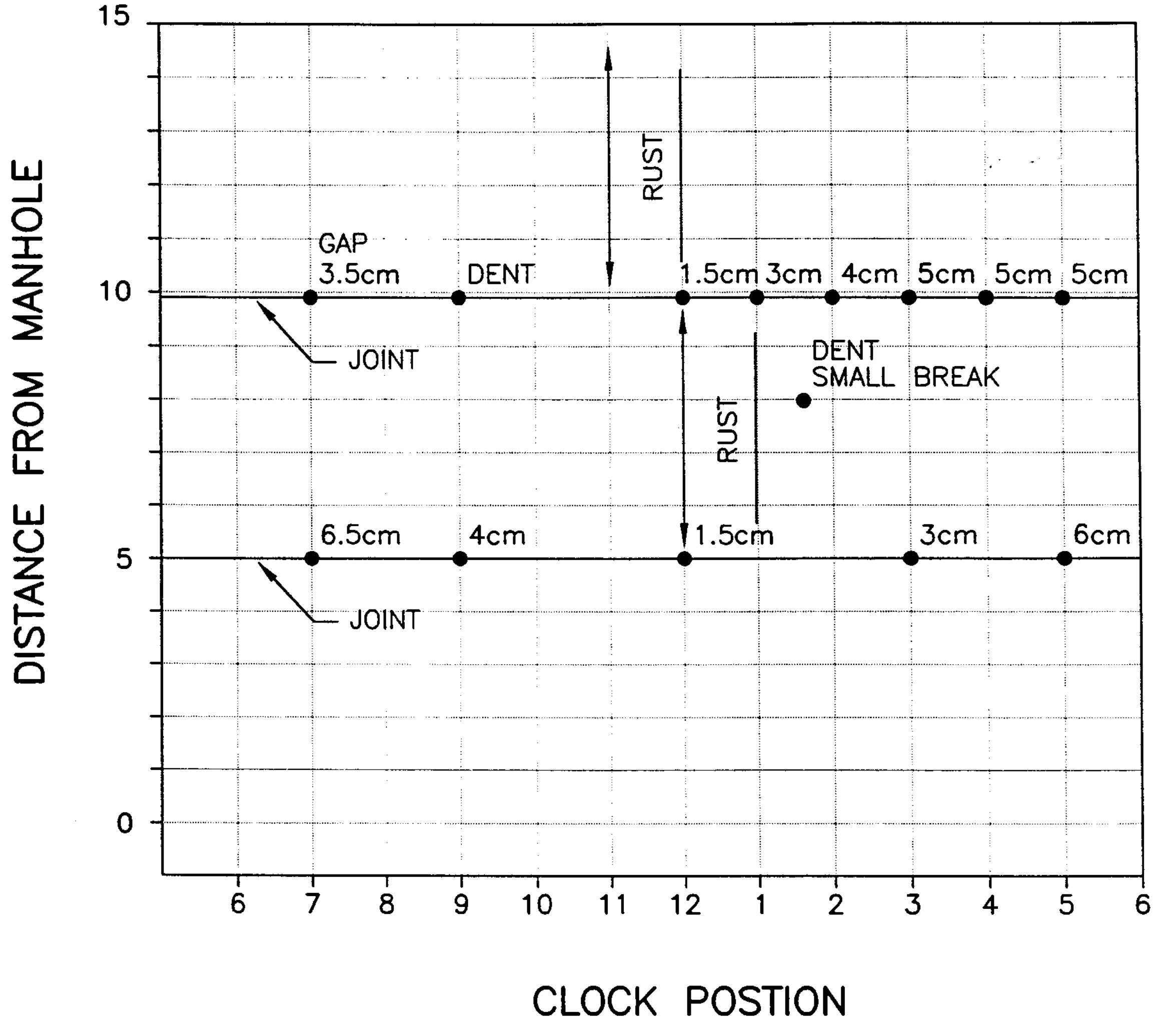
Clock Reference Looking DOWNSTREAM

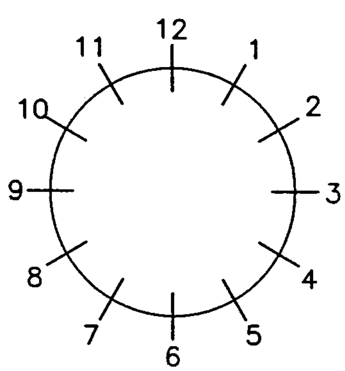
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A42	

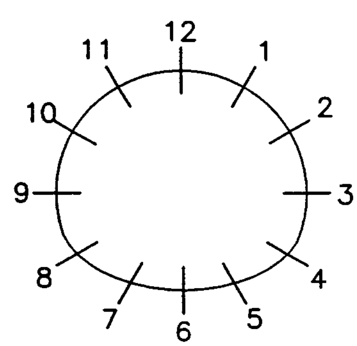
KGS FILE NO.: 97-107-12A42

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



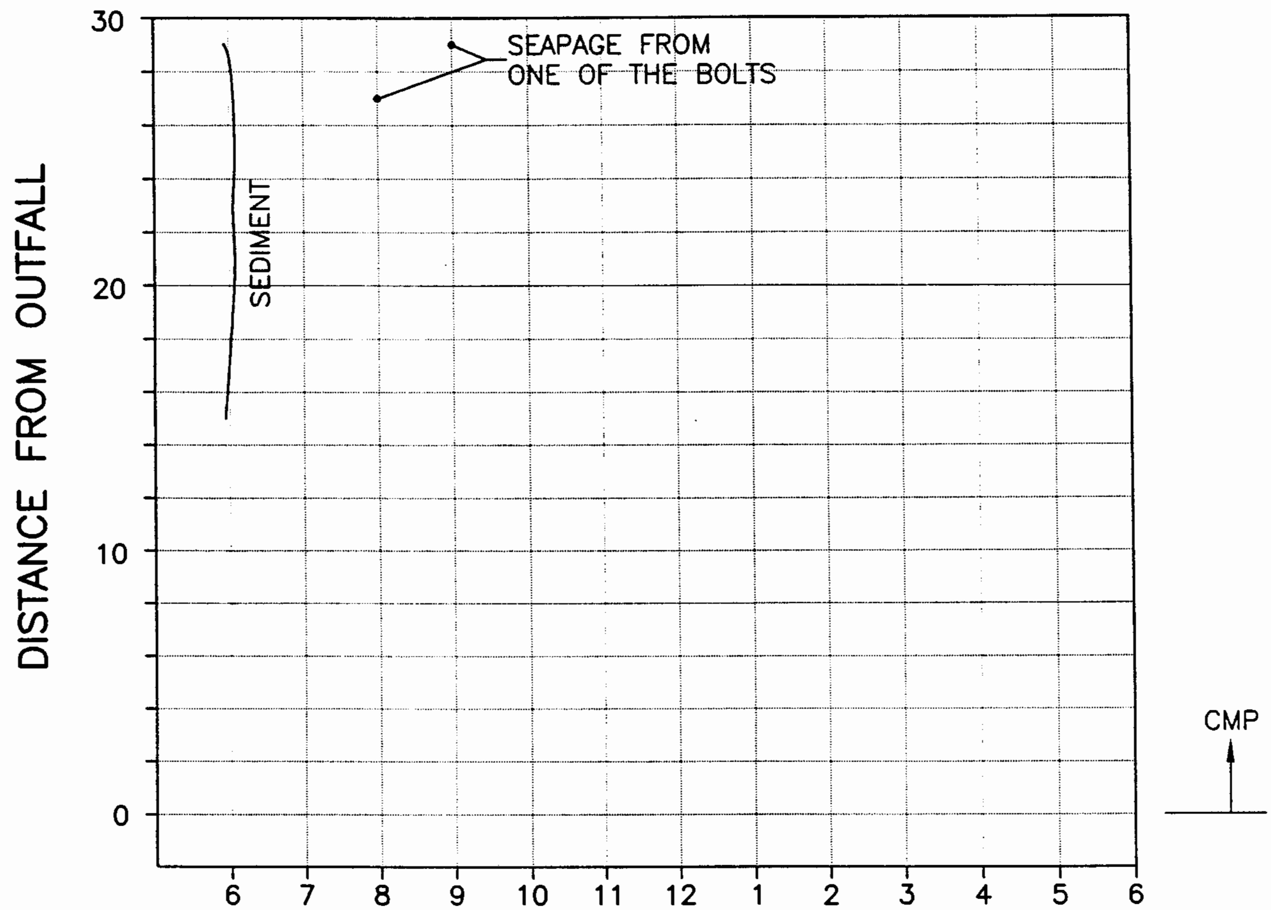
Clock Reference Looking
DOWNSTREAM

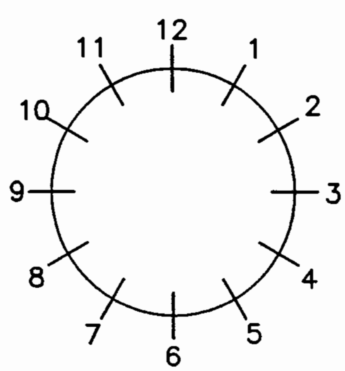
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A52	

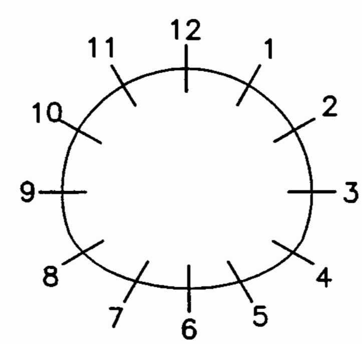
KGS FILE NO.: 97-107-12A52

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



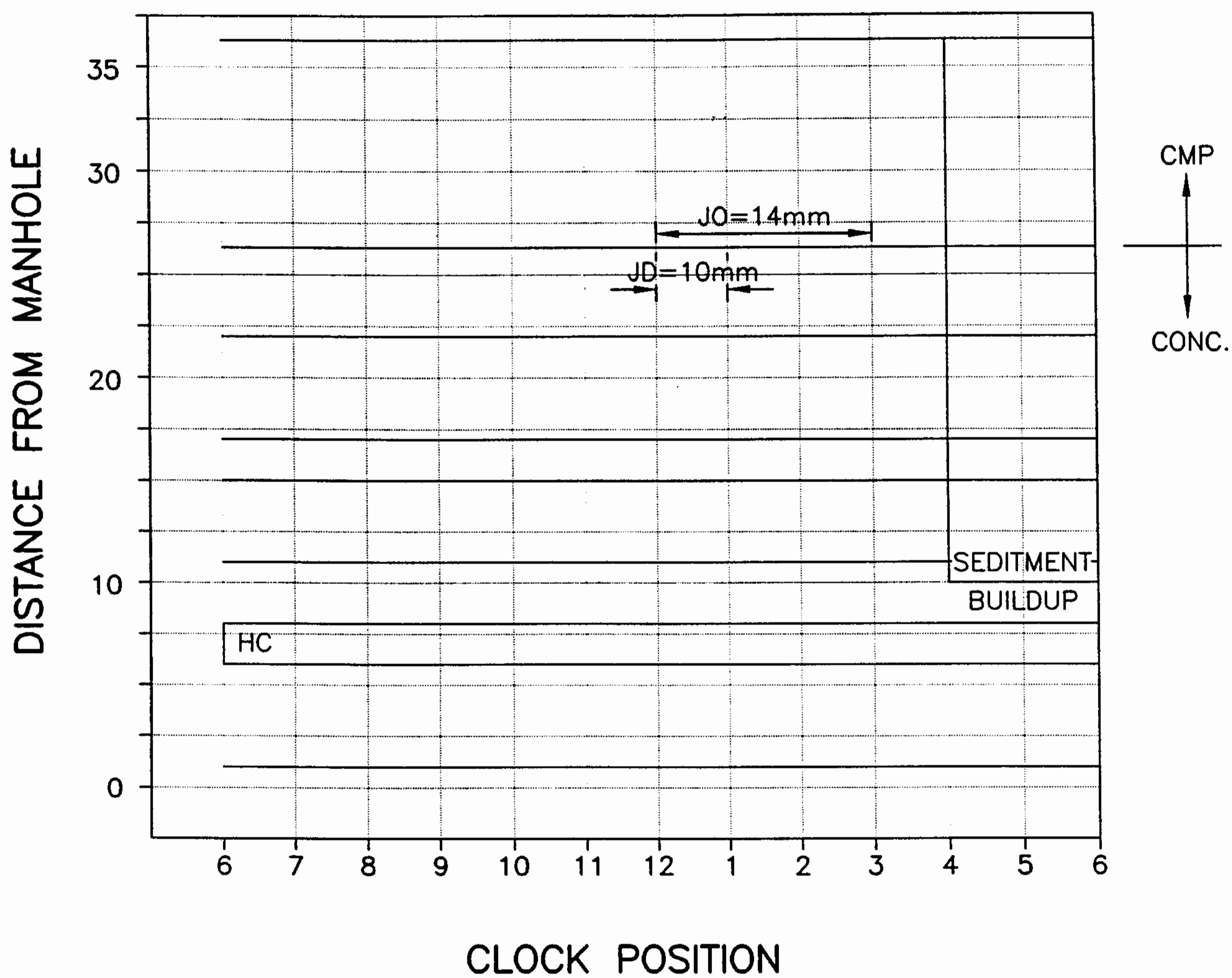
Clock Reference Looking
DOWNSTREAM

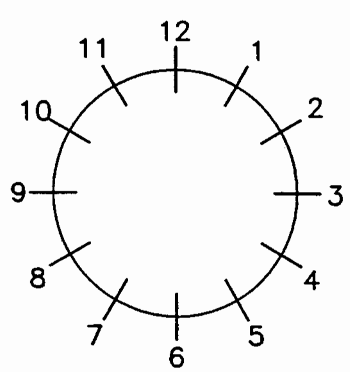
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A58	

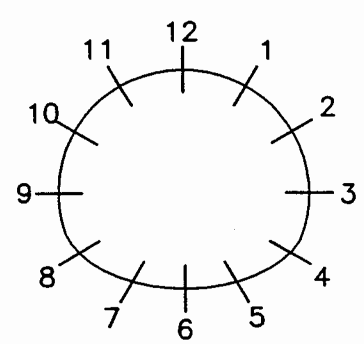
KGS FILE NO.: 97-107-12A58

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



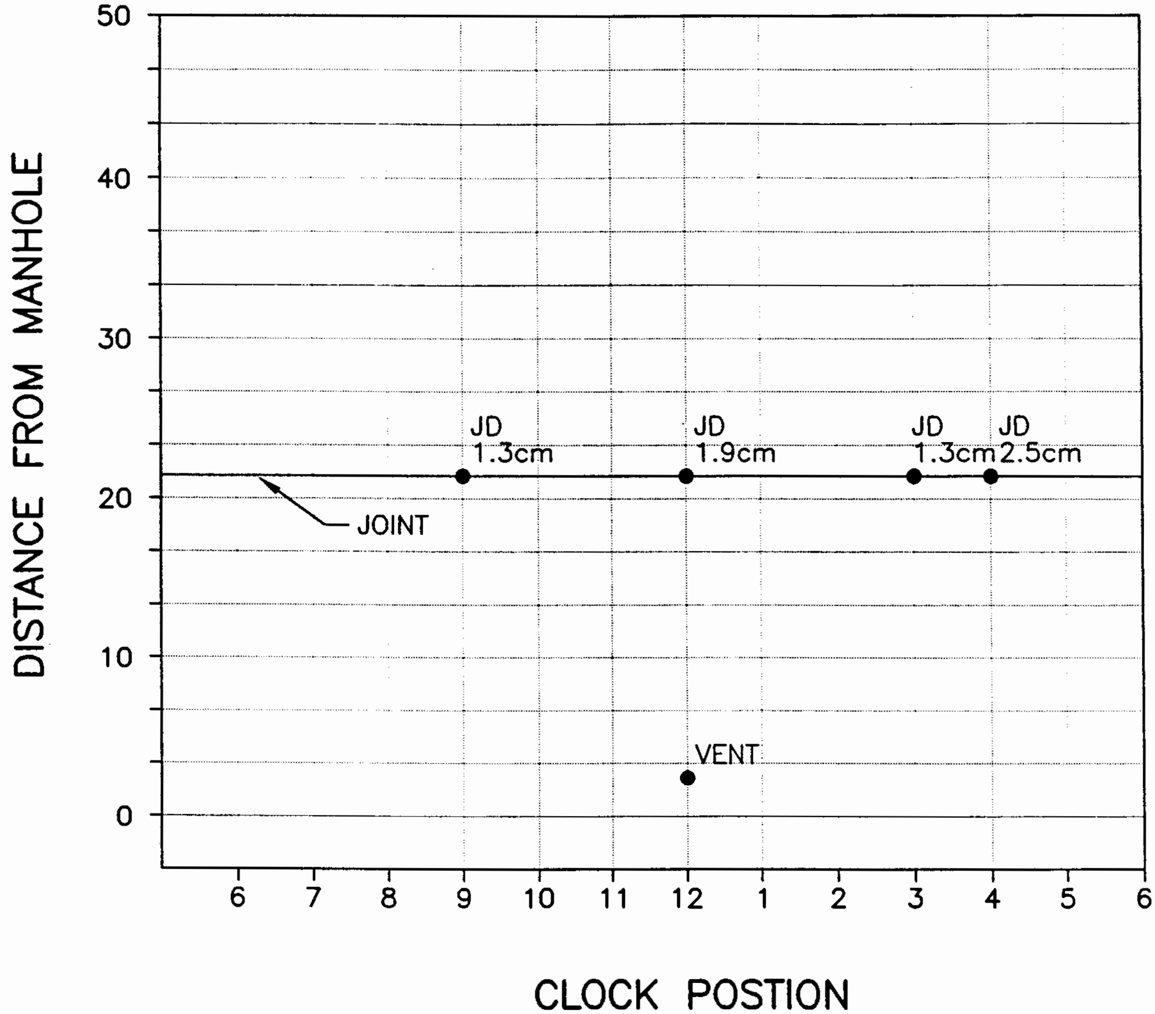
Clock Reference Looking
DOWNSTREAM

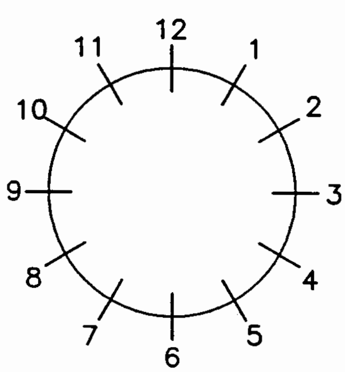
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A63	

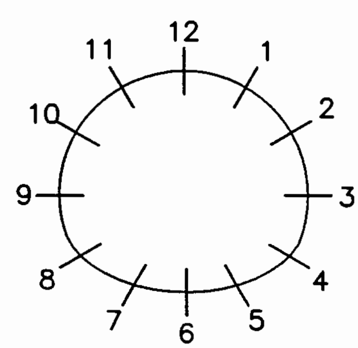
KGS FILE NO.: 97-107-12A63

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



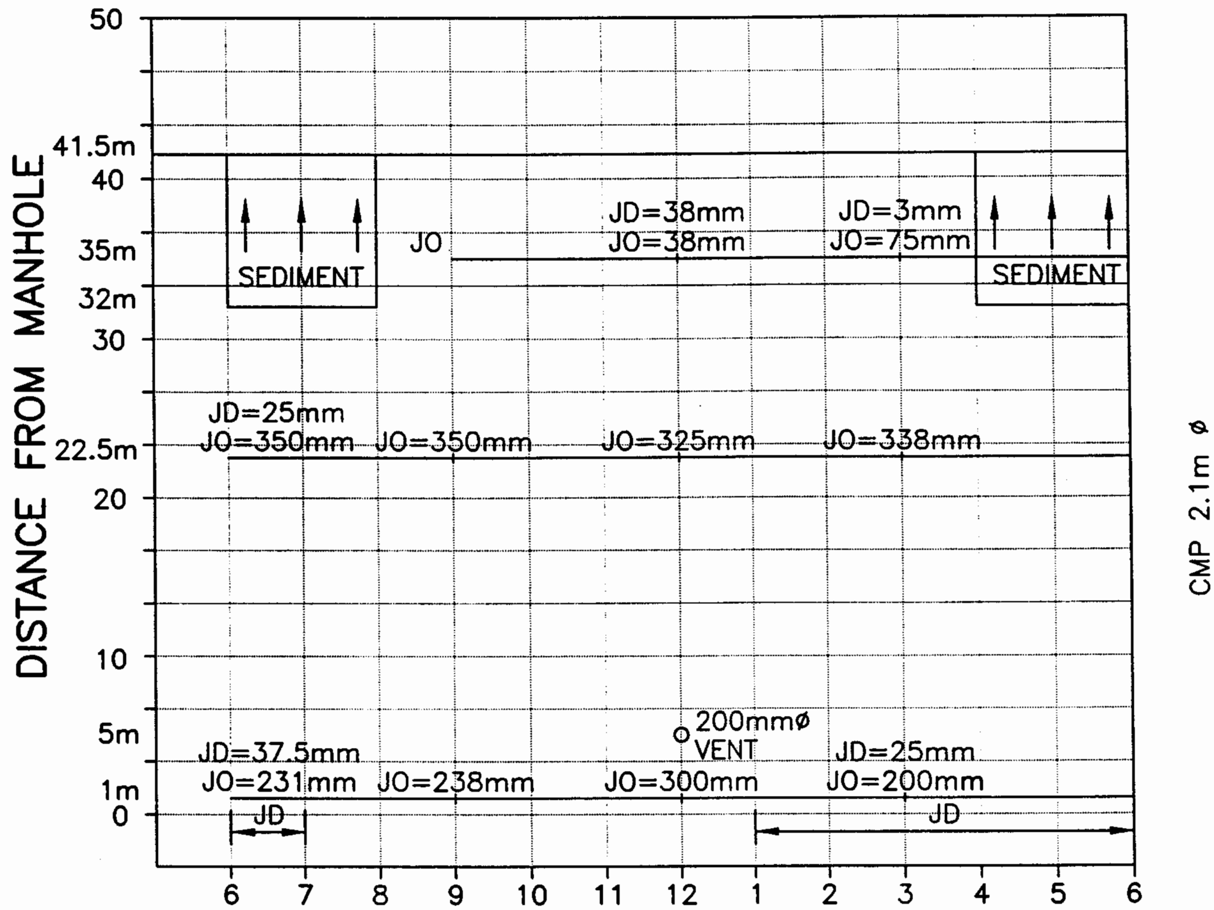
Clock Reference Looking DOWNSTREAM

LEGEND:

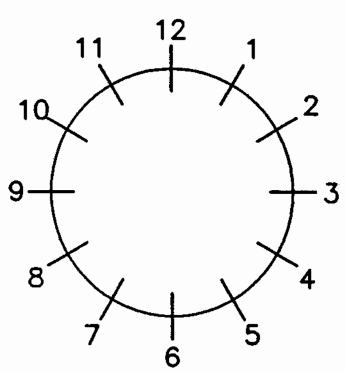
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A69	

KGS FILE NO.: 97-107-12A69

STRUCTURE CONDITION MAPPING CHART



CLOCK POSITION



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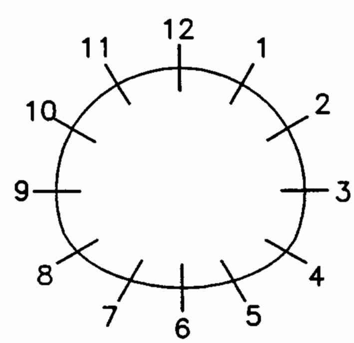


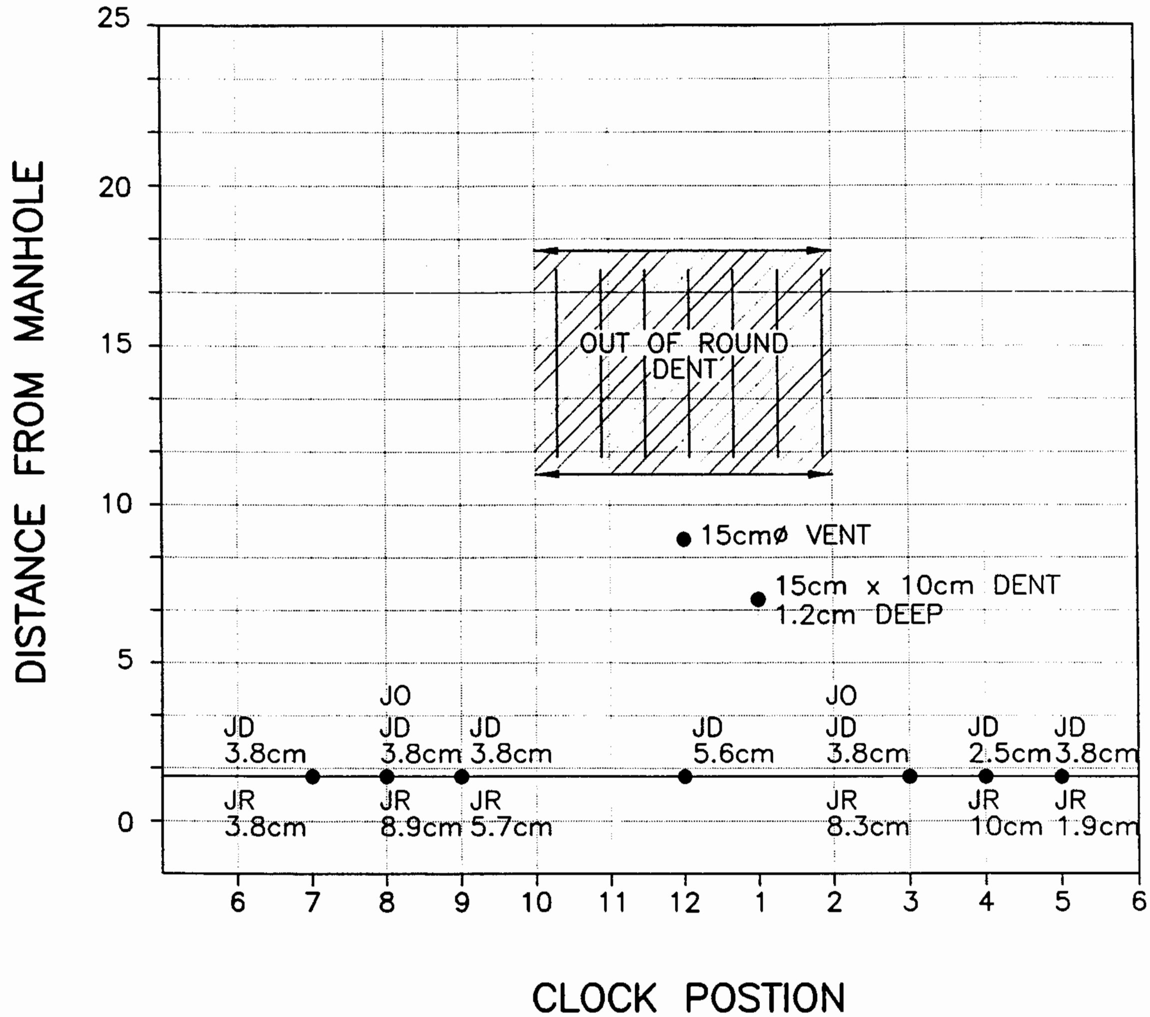
Clock Reference Looking
DOWNSTREAM

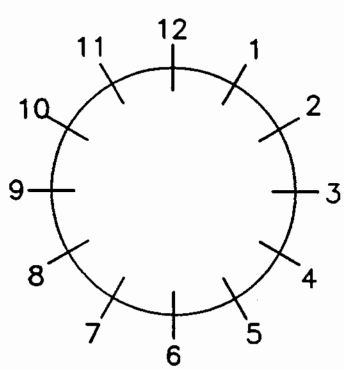
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A74	

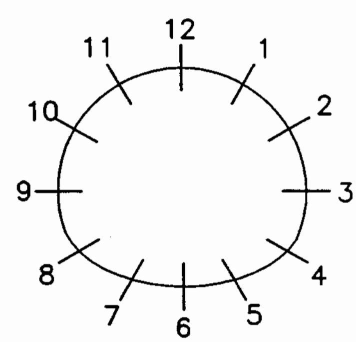
KGS FILE NO.: 97-107-12A74

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



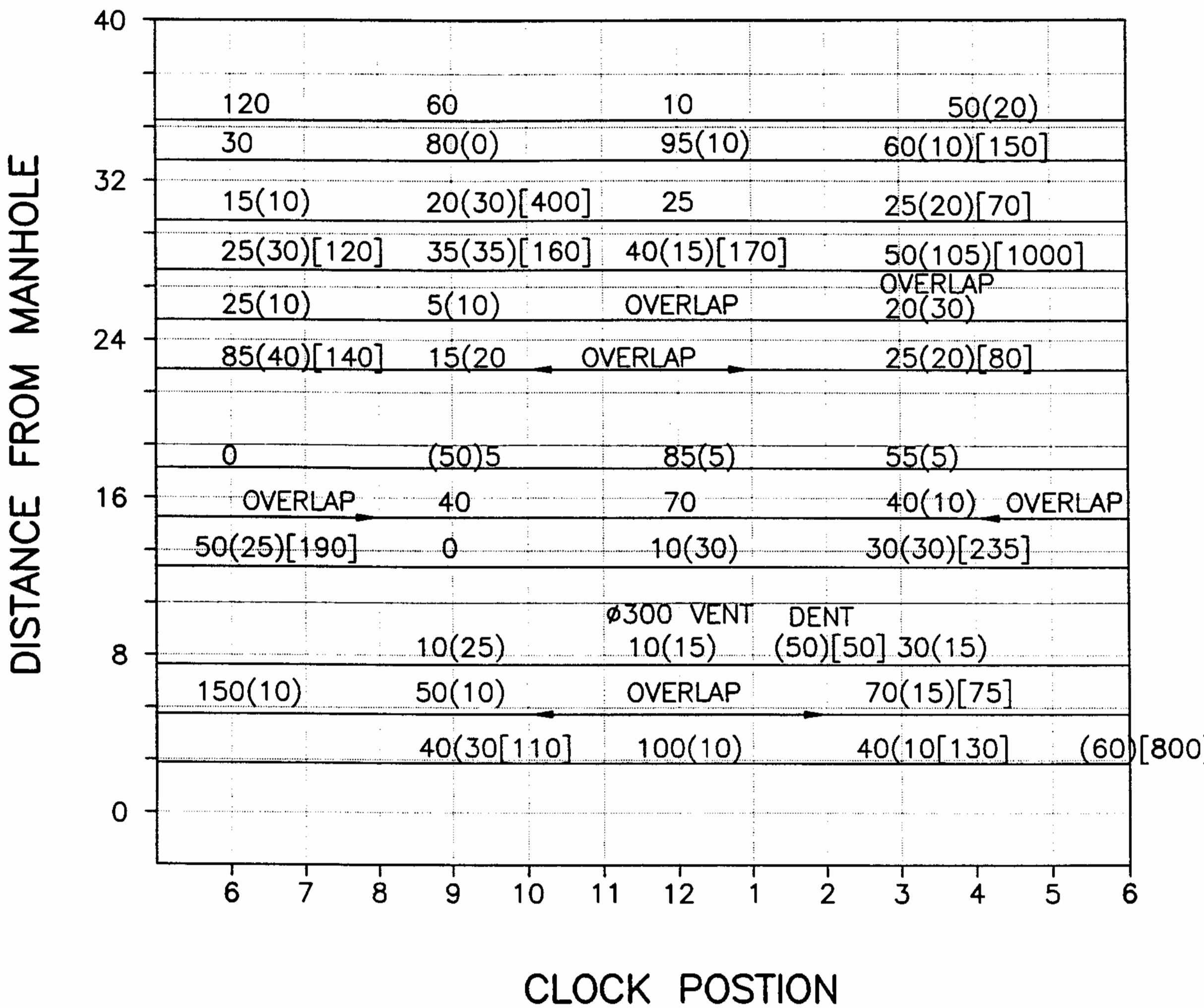
Clock Reference Looking
DOWNSTREAM

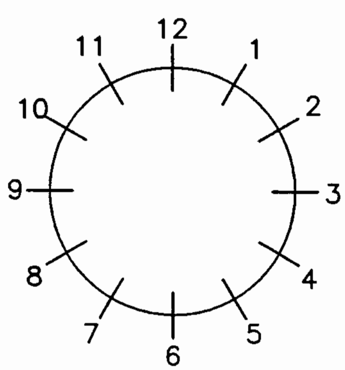
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A75	

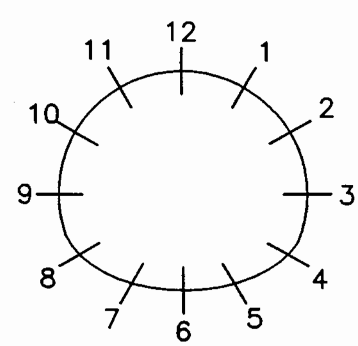
KGS FILE NO.: 97-107-12A75

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



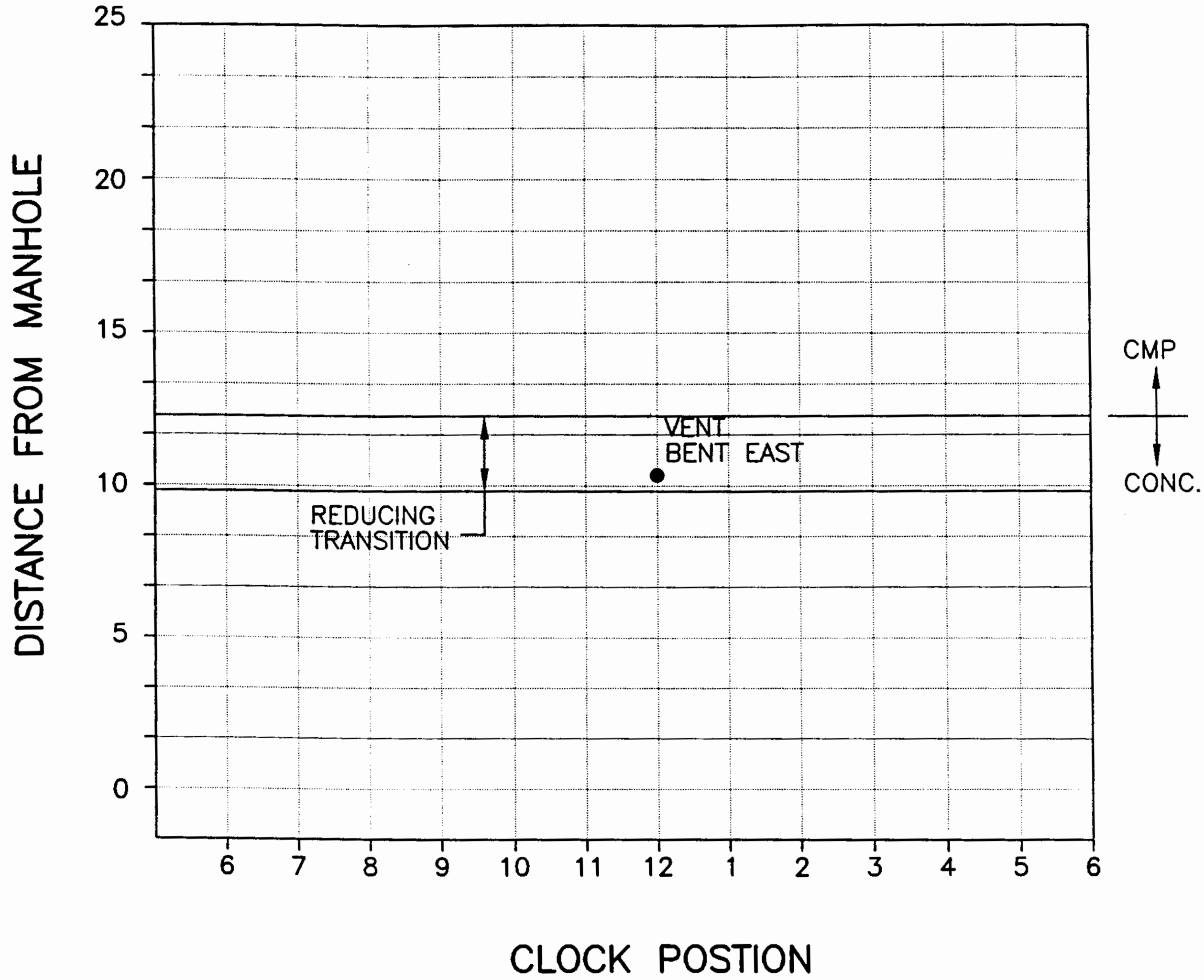
Clock Reference Looking
DOWNSTREAM

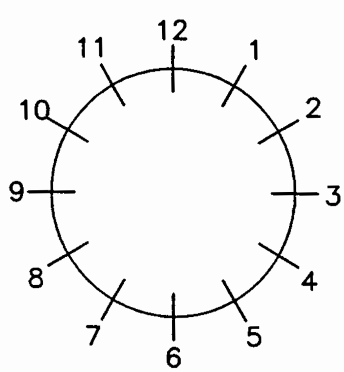
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A-76	

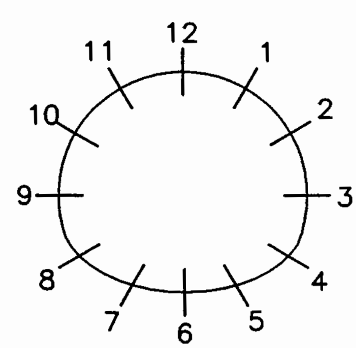
KGS FILE NO.: 97-107-12A76

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



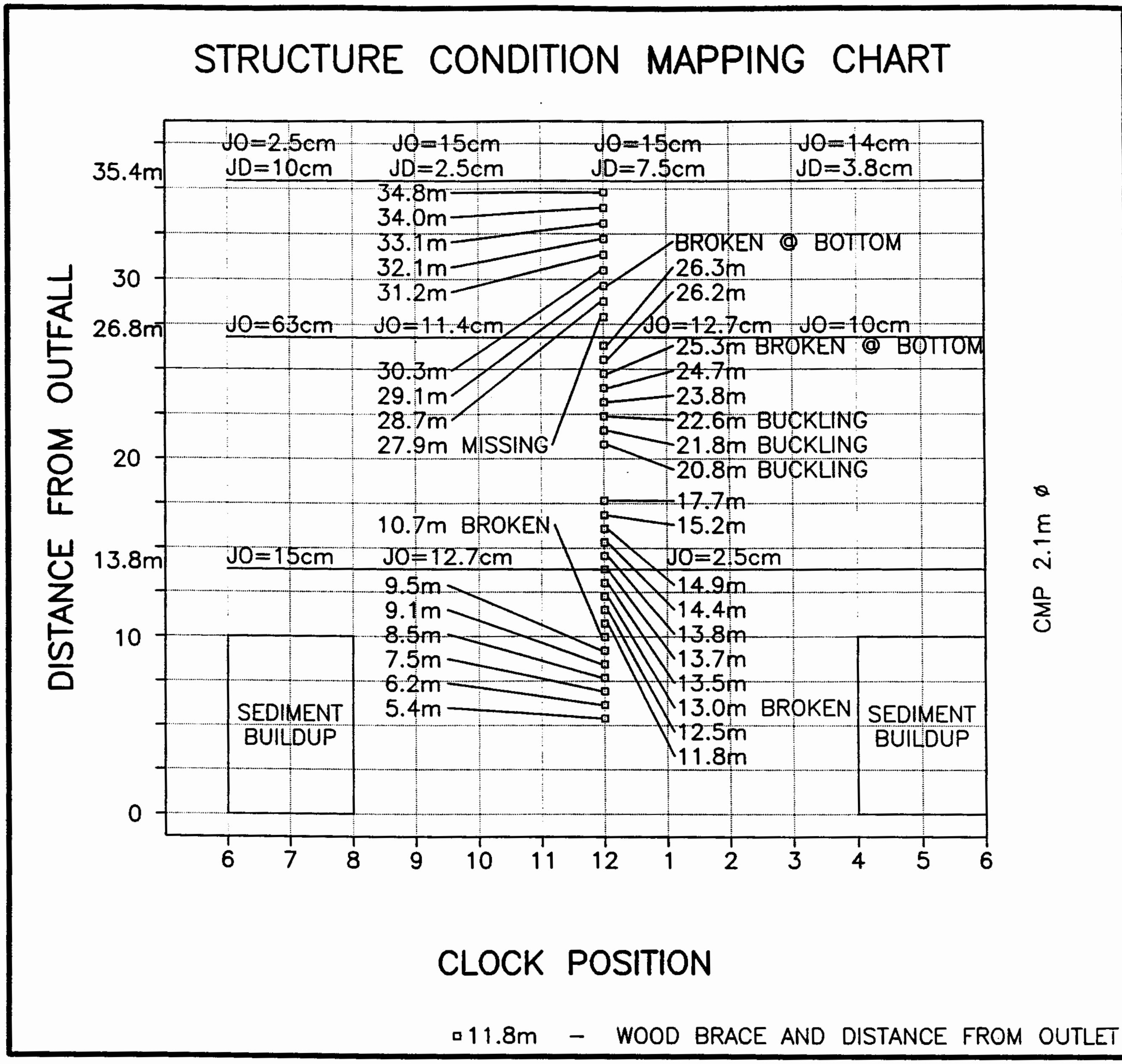
Clock Reference Looking
DOWNSTREAM

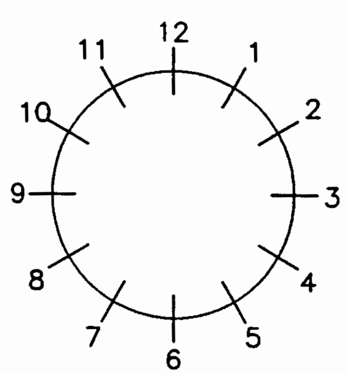
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A80	

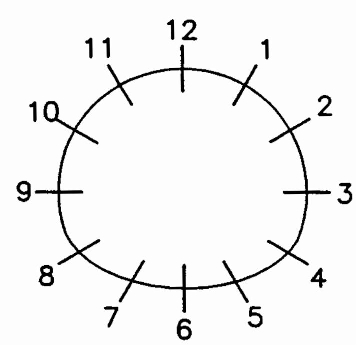
KGS FILE NO.: 97-107-12A80

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



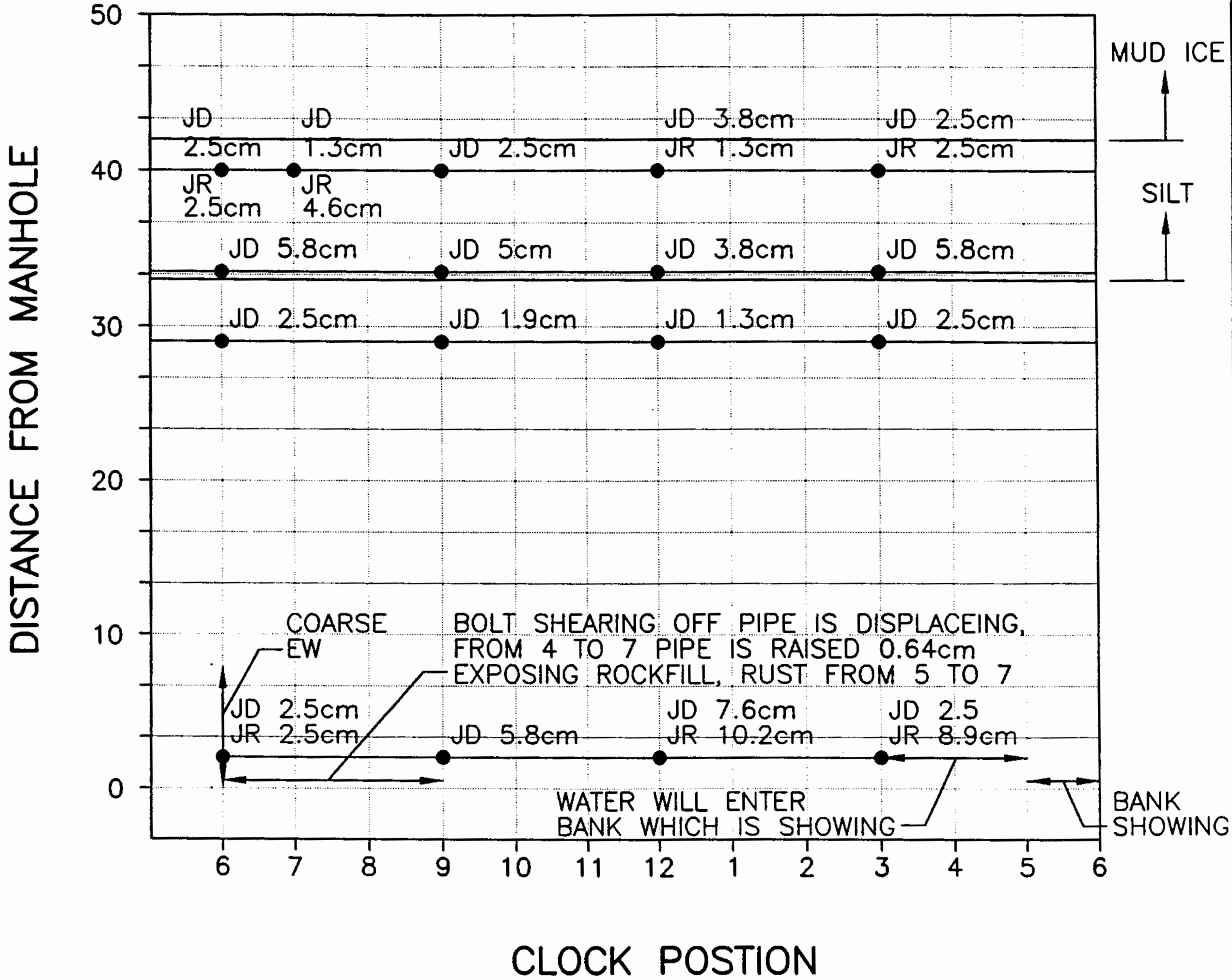
Clock Reference Looking
DOWNSTREAM

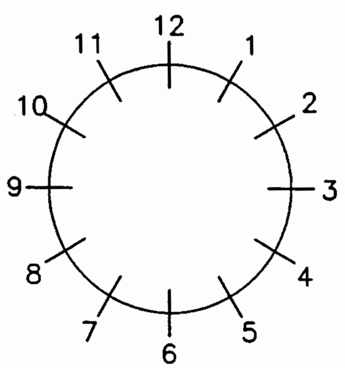
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A81	

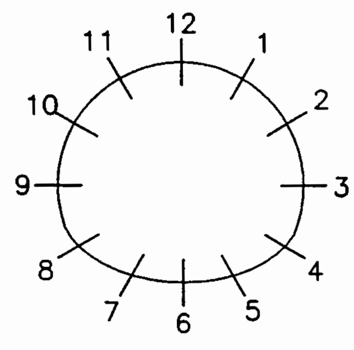
KCS FILE NO.: 97-107-12A81

STRUCTURE CONDITION MAPPING CHART





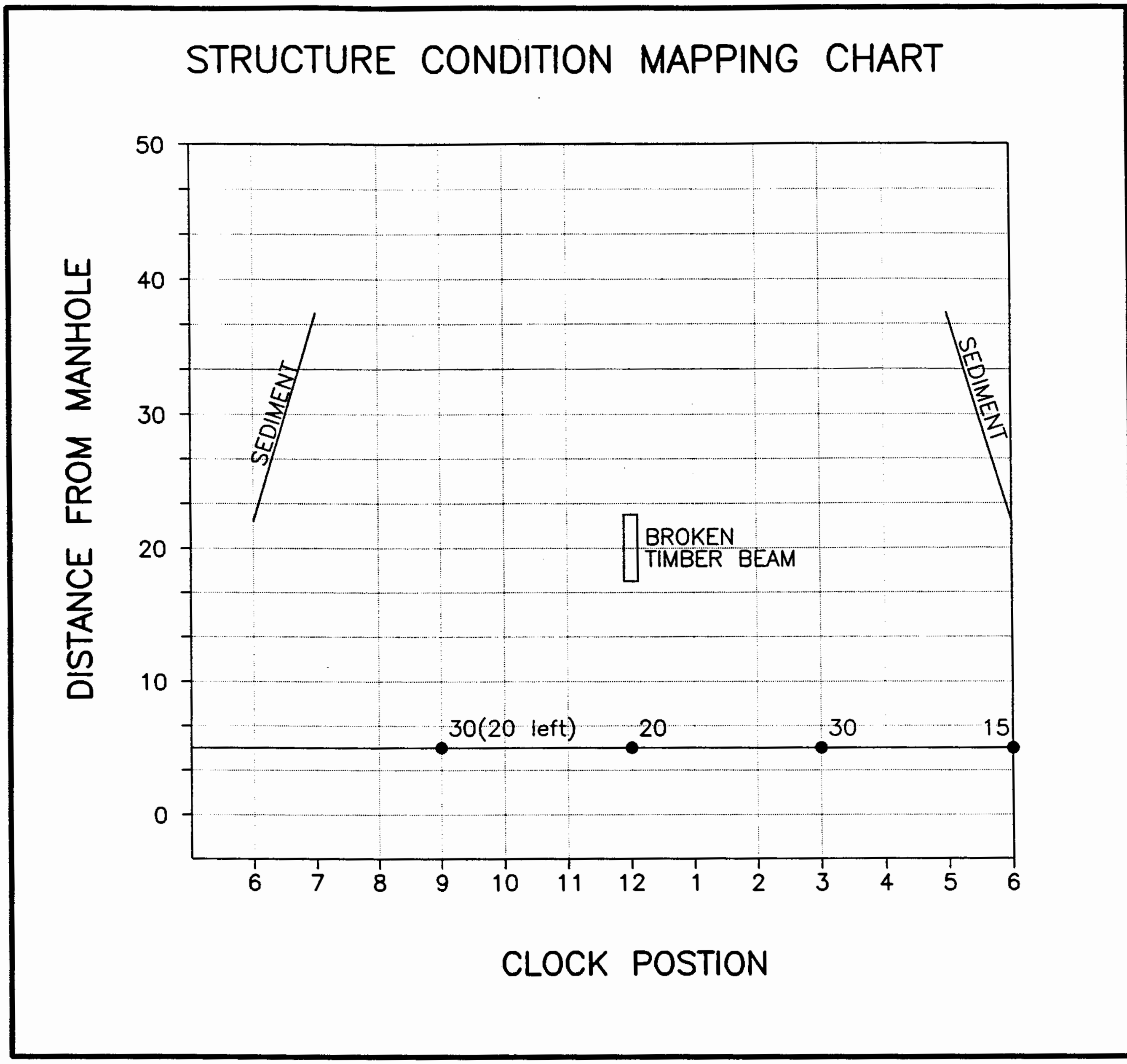
Clock Reference Looking
DOWNSTREAM

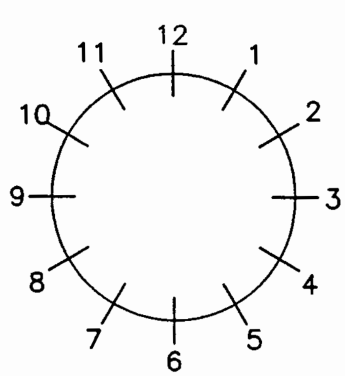


Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A86	





Clock Reference Looking
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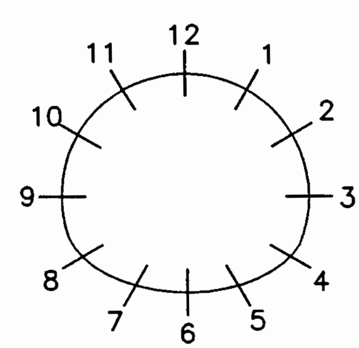
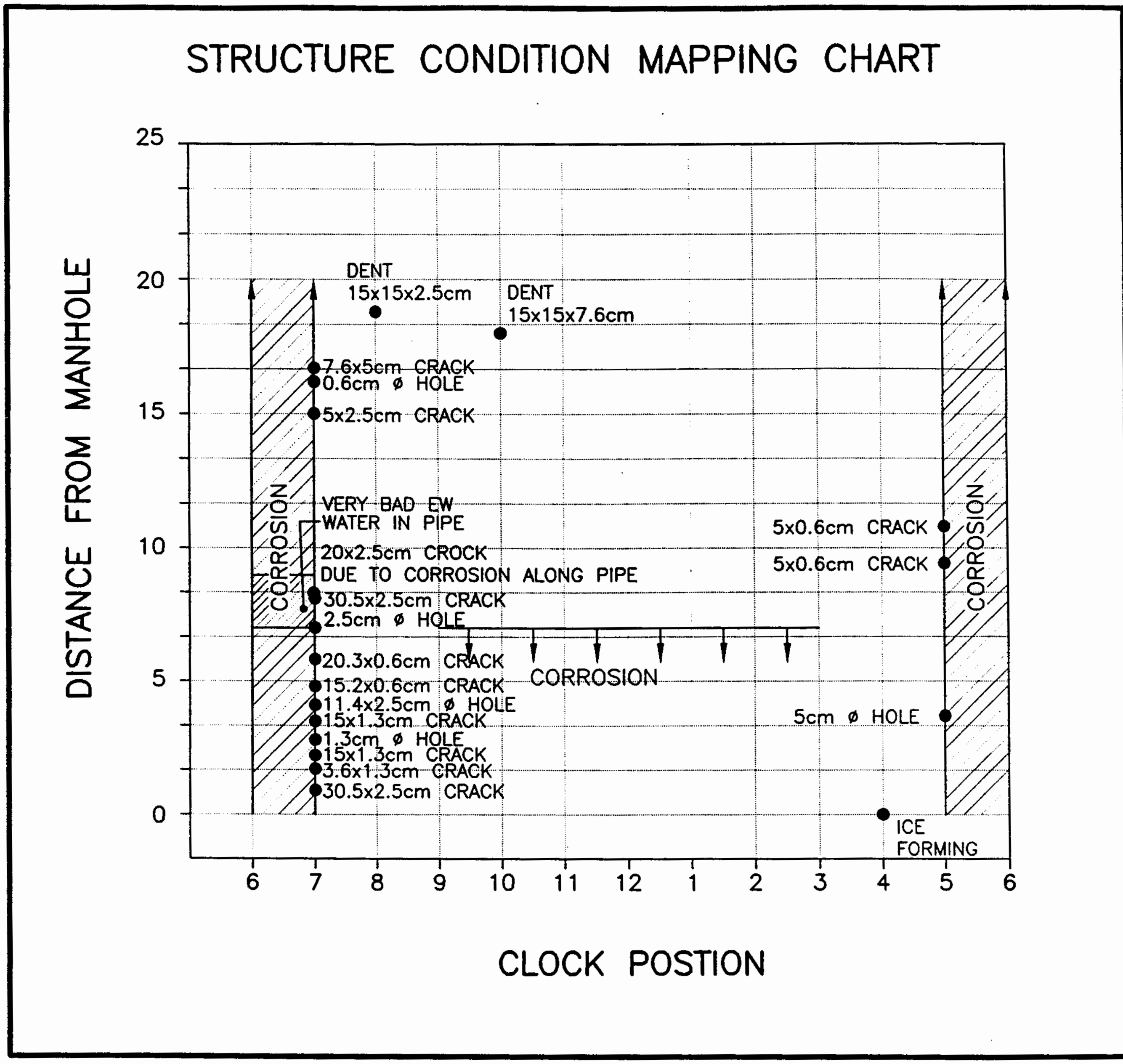


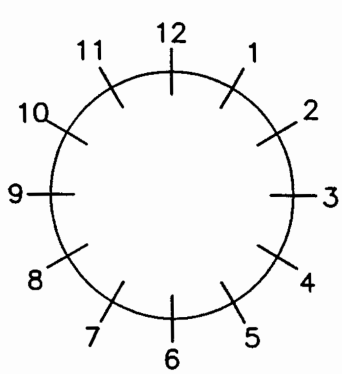
Clock Reference Looking
DOWNSTREAM

LEGEND:

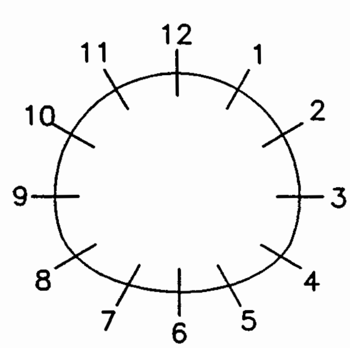
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A87	

KGS FILE NO.: 97-107-12A87





Clock Reference Looking
DOWNSTREAM



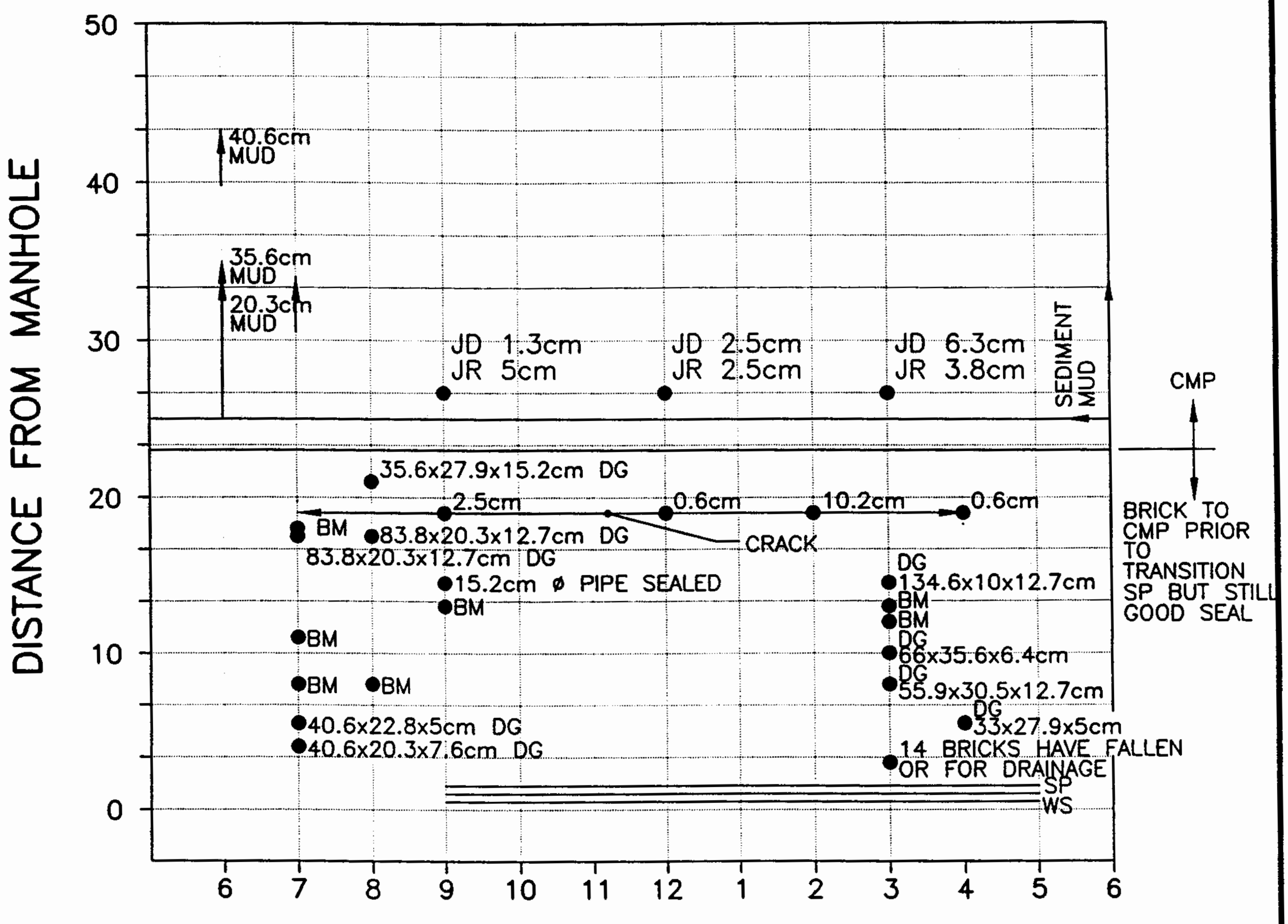
Clock Reference Looking
DOWNSTREAM

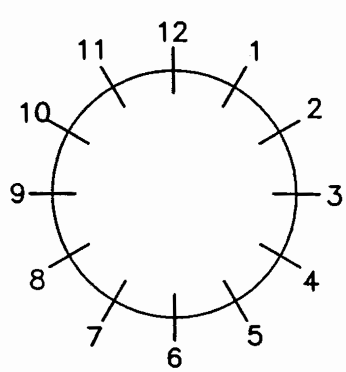
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Raised	JR
	Delaminated	DC	PIPE IDENTIFICATION:	A88	

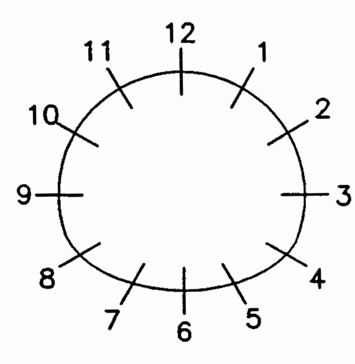
KCS FILE NO.: 97-107-12A88

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



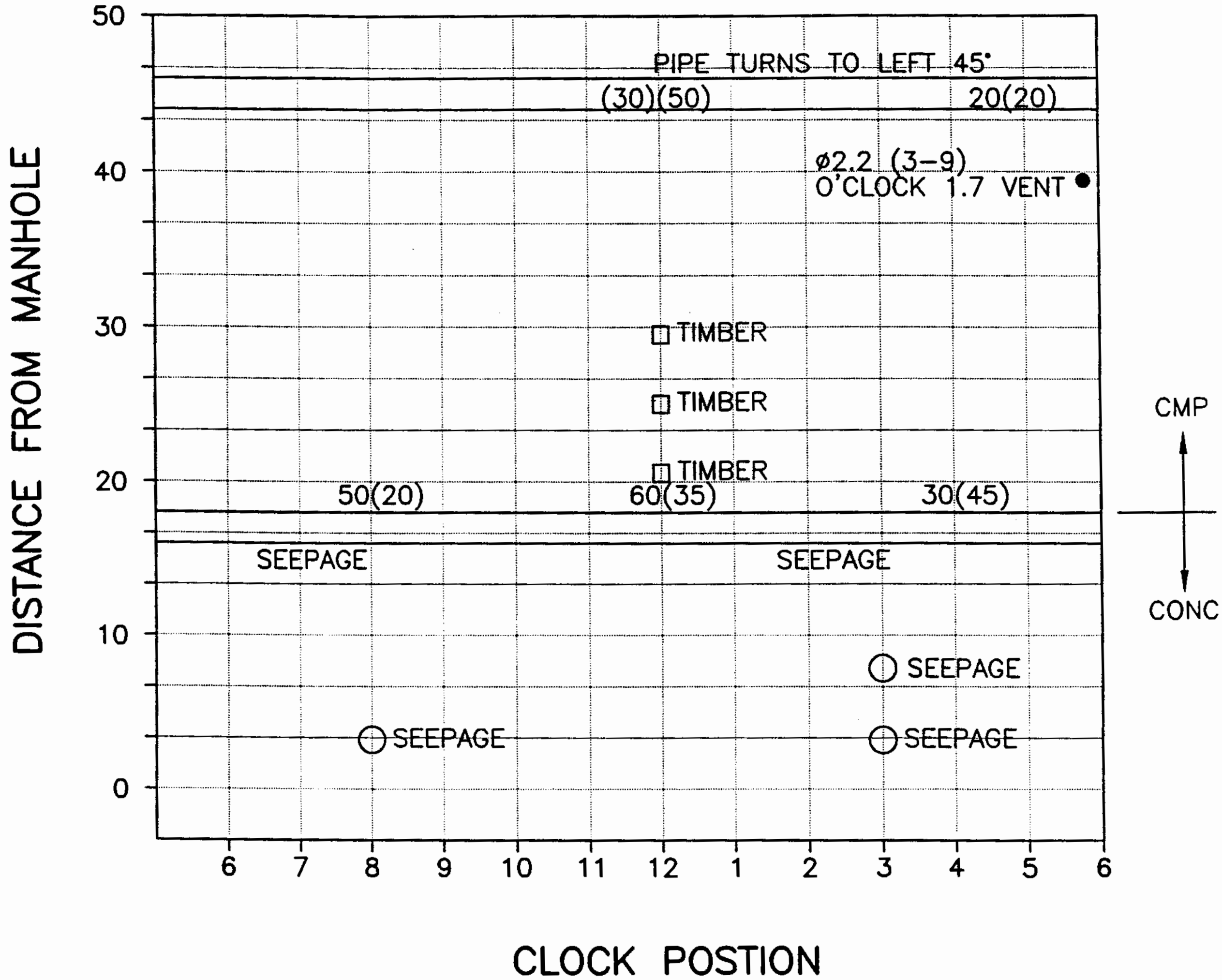
Clock Reference Looking
DOWNSTREAM

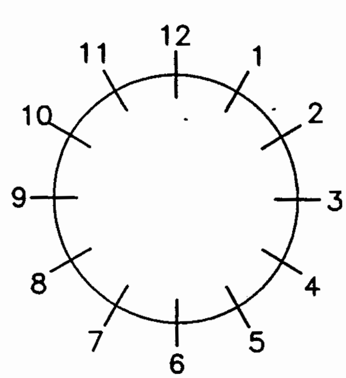
LEGEND:

DEFECTIVE CONCRETE:				JOINTS:		
DG	DEEP GAP	Spalling	SP		Raised	JR
BM	BRICK MISSING	Honeycomb	HC		Displaced	JD
WS	WATER SEEPAGE	Erosion/Wear	EW		Spalled	SP
		Delaminated	DC	PIPE IDENTIFICATION:	A90	

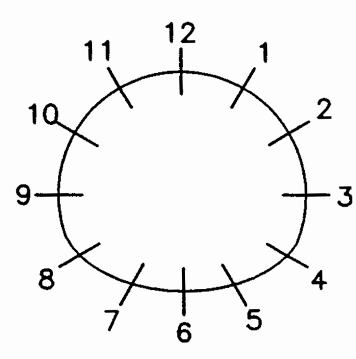
KGS FILE NO.: 97-107-12A90

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



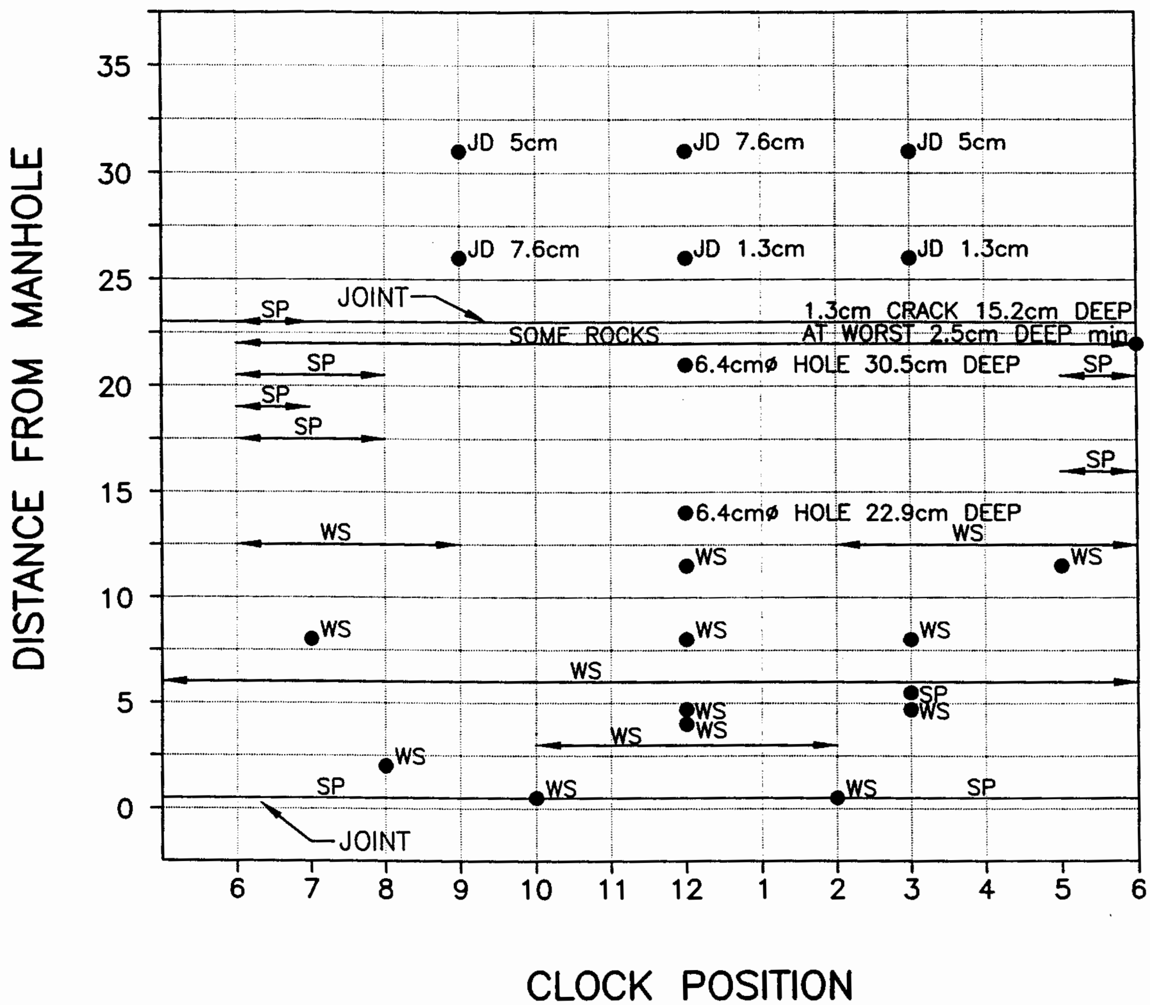
Clock Reference Looking DOWNSTREAM

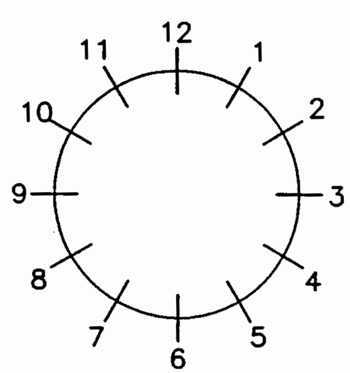
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A94	

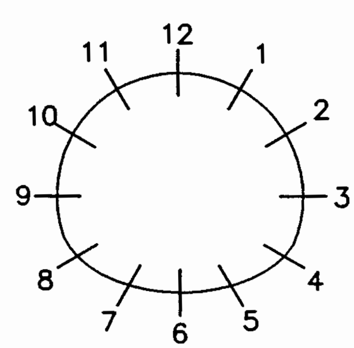
KGS FILE NO.: 97-107-12A94

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



Clock Reference Looking
DOWNSTREAM

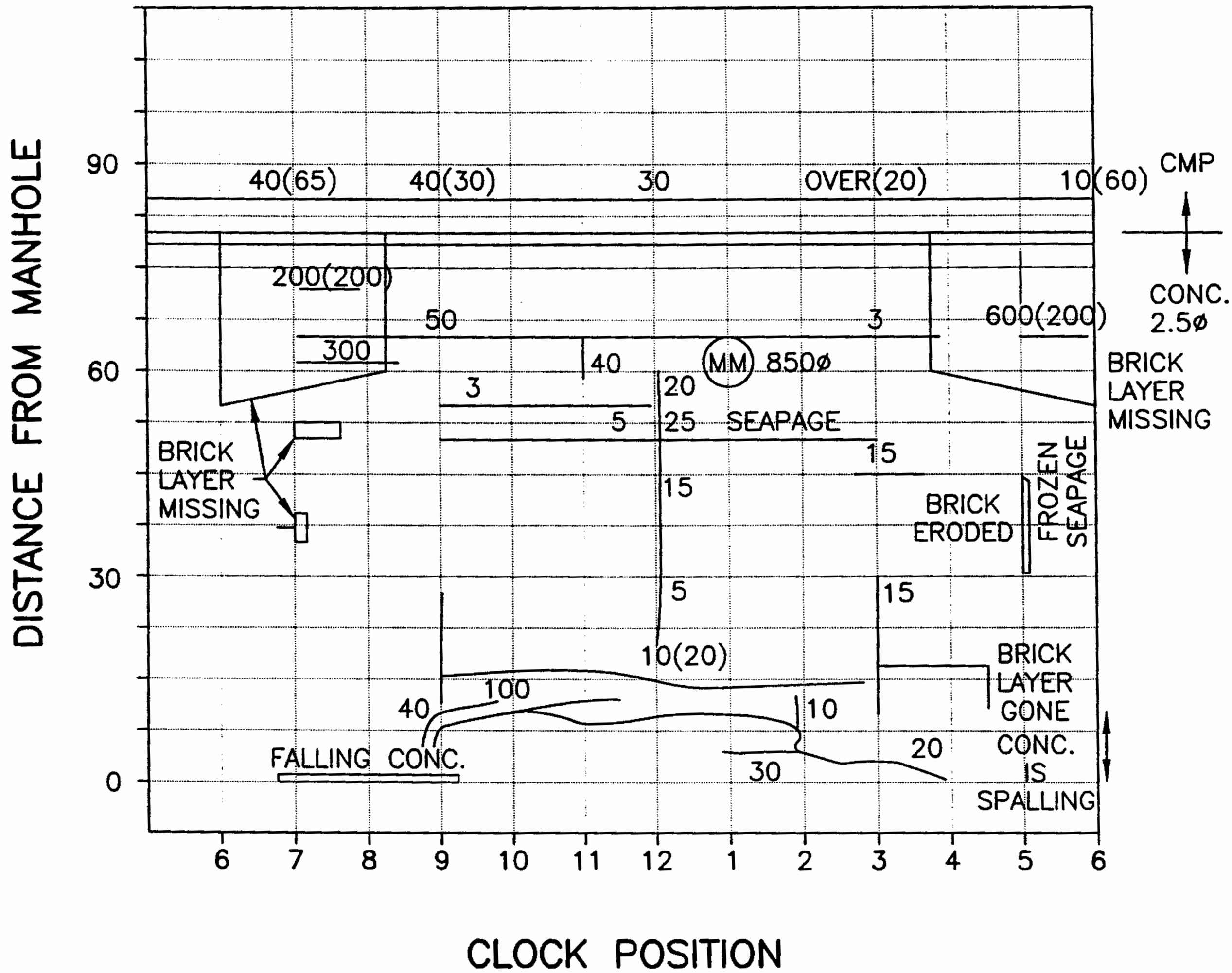
LEGEND:

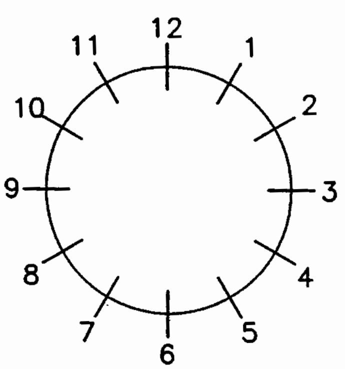
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	A95	

KGS FILE NO.: 97-107-12A95

SEINE RIVER

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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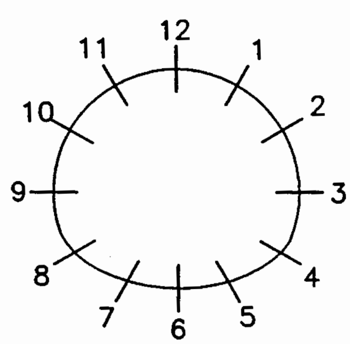


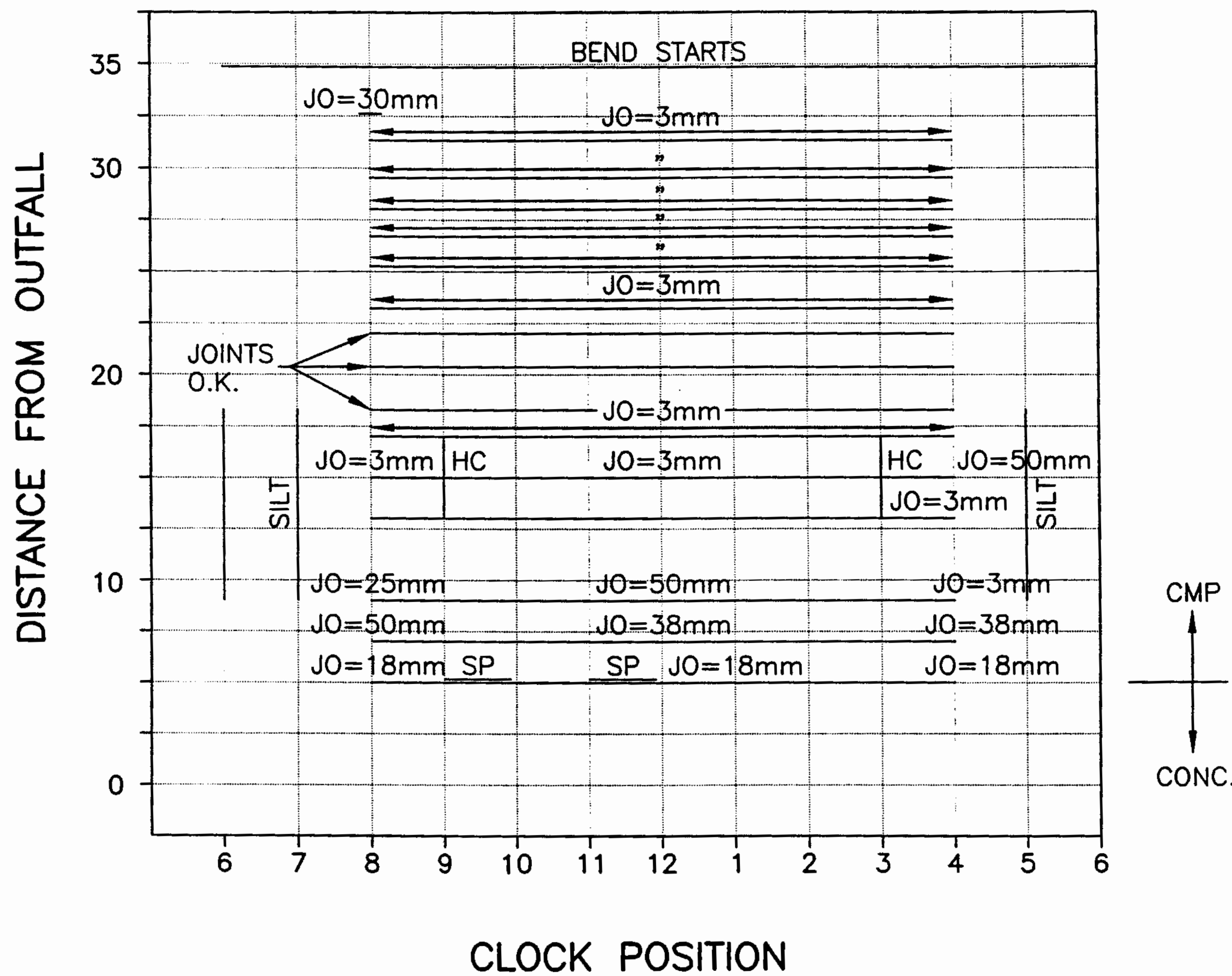
Clock Reference Looking
DOWNSTREAM

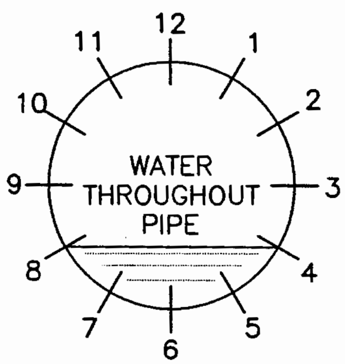
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	SE1	

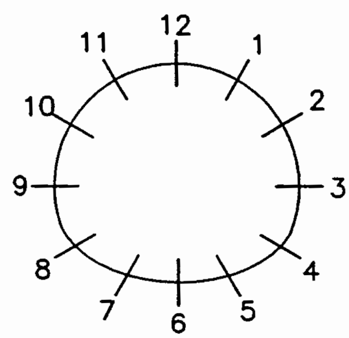
KGS FILE NO.: 97-107-12SE1

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



Clock Reference Looking DOWNSTREAM

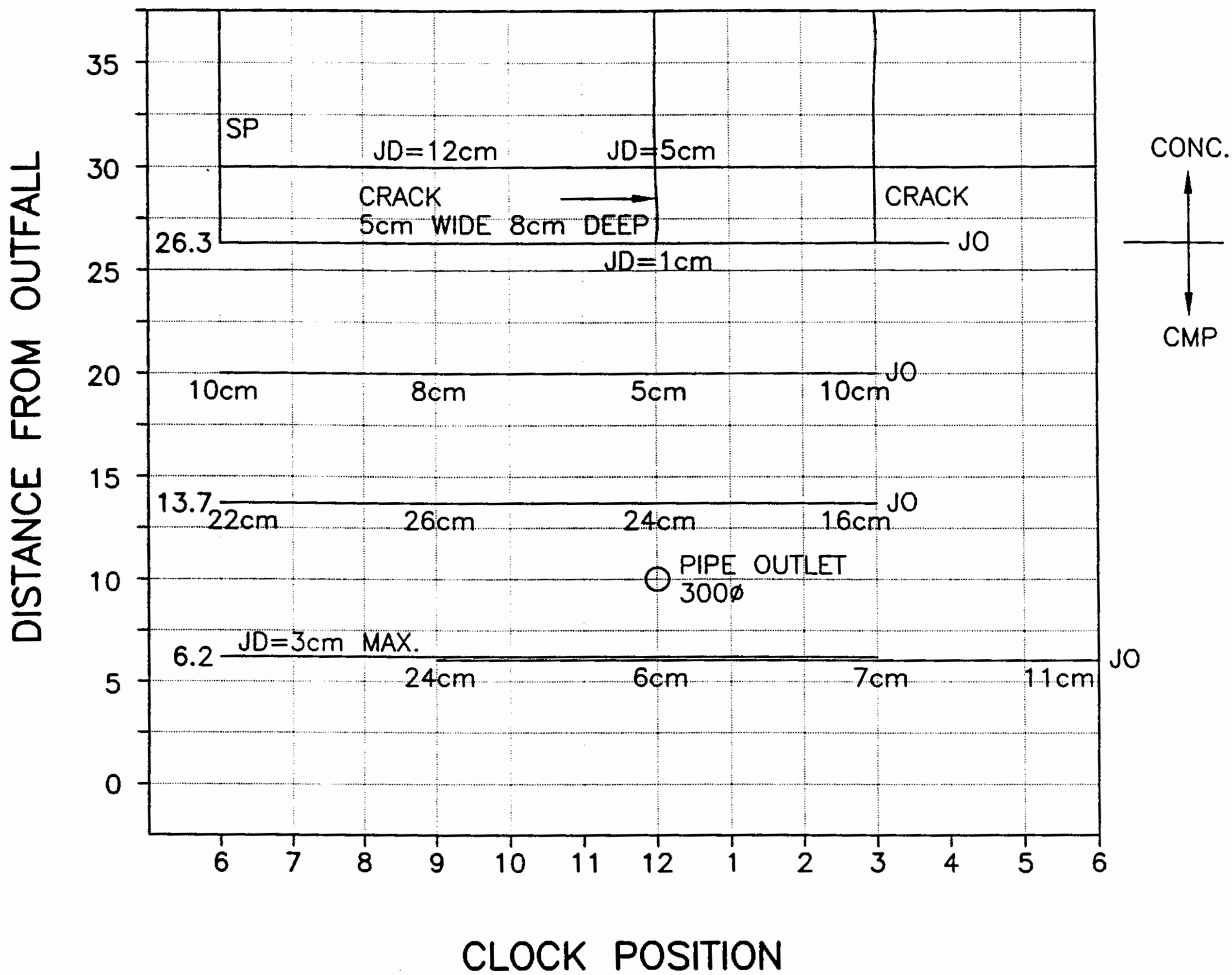
LEGEND:

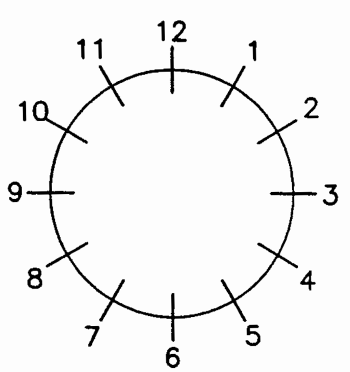
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	SE34	

KGS FILE NO.: 97-107-12SE34

STURGEON CREEK

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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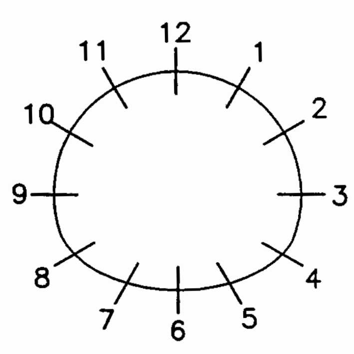
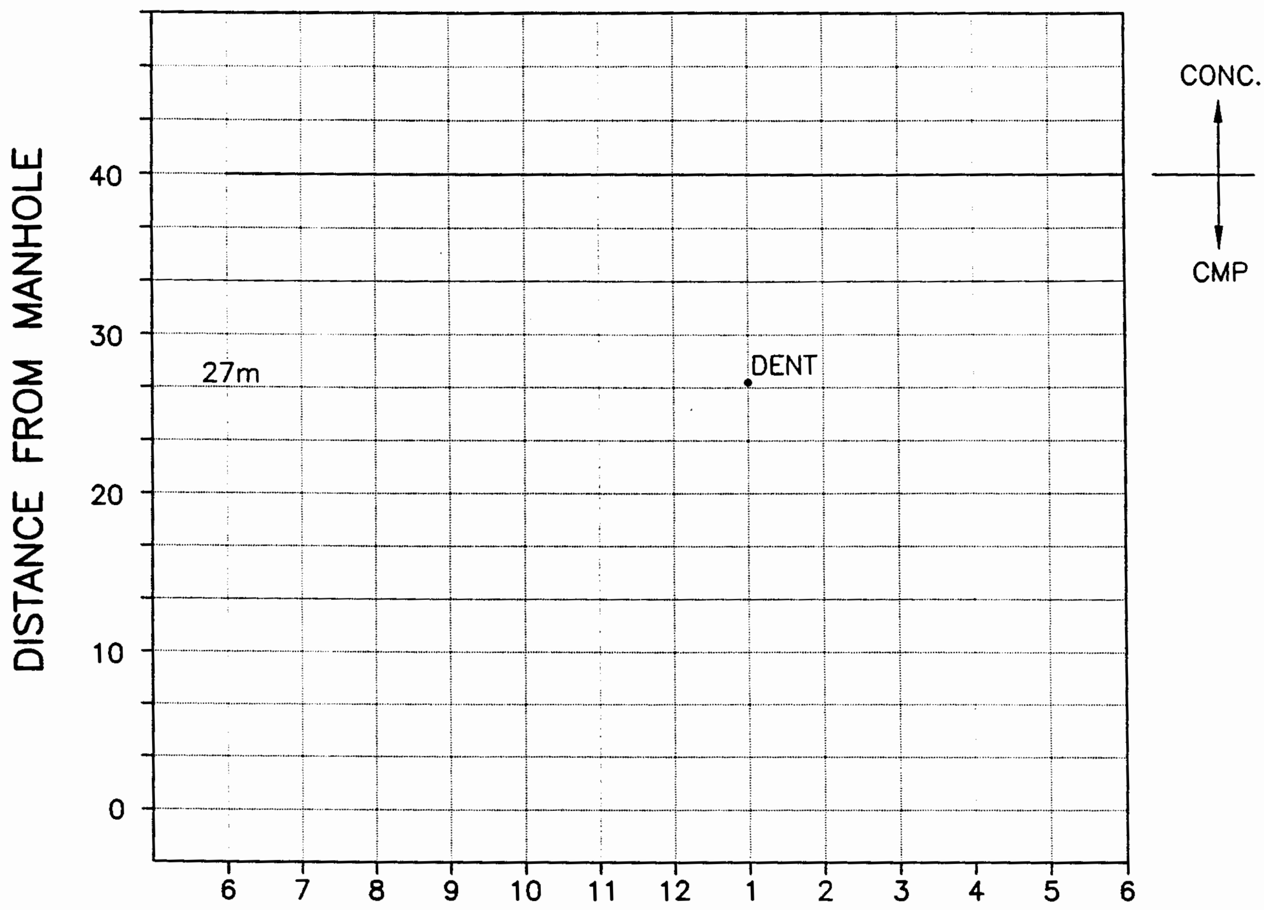


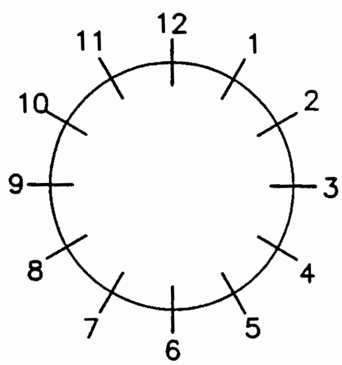
Clock Reference Looking
DOWNSTREAM

LEGEND:

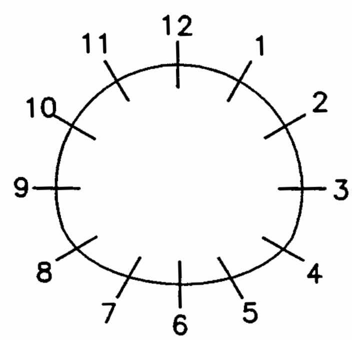
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	ST3	

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM

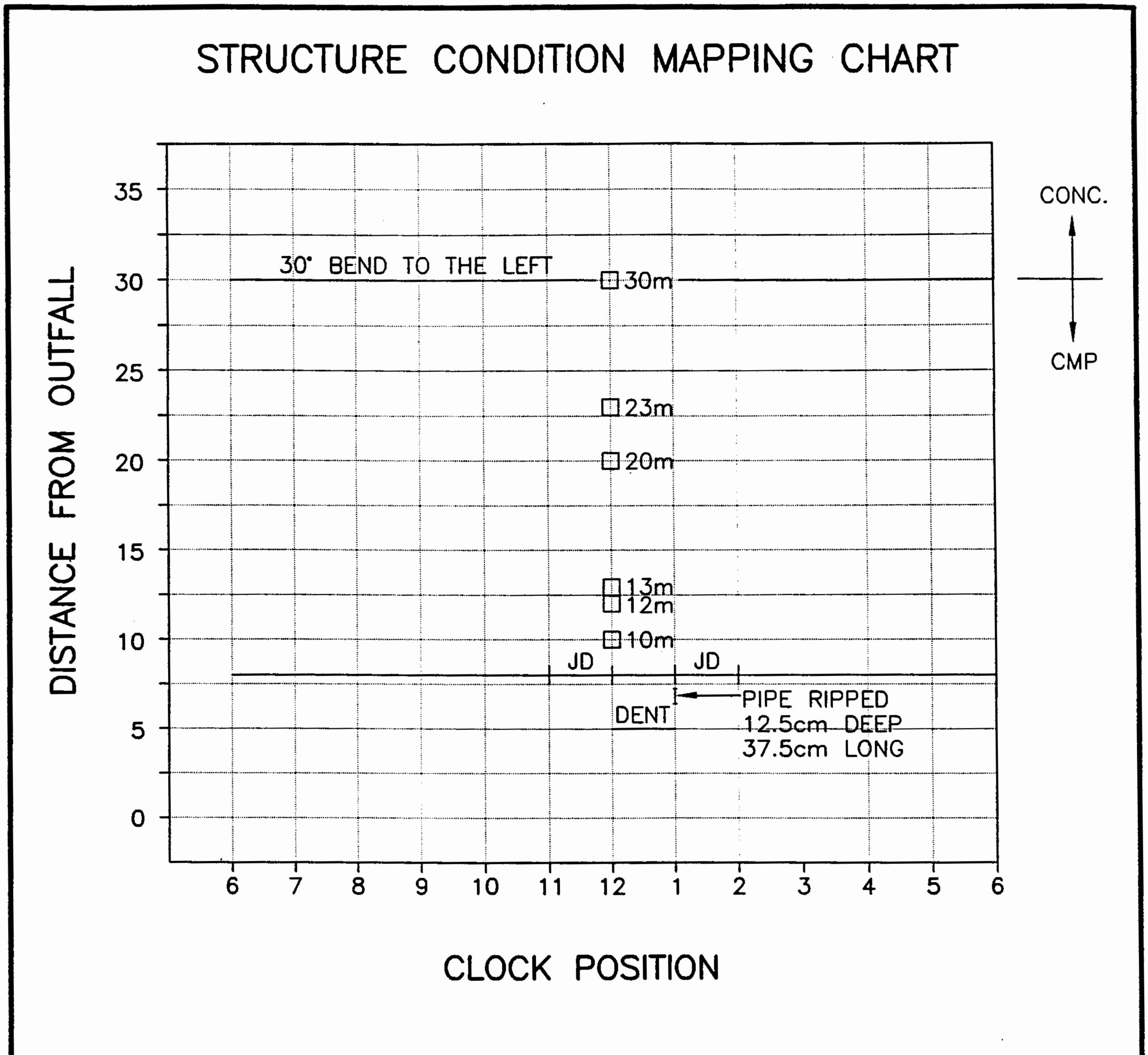


Clock Reference Looking
DOWNSTREAM

LEGEND:

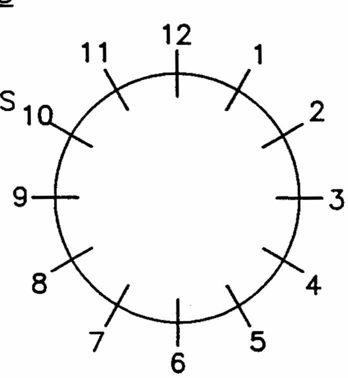
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	ST18	

KGS FILE NO.: 97-107-12ST18



LEGEND

□ 4"x4" WOOD BRACES



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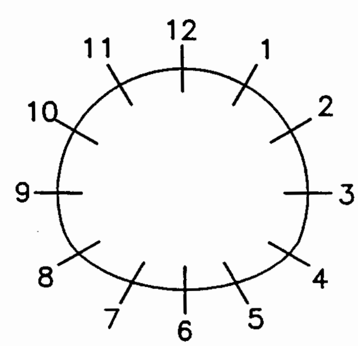


Clock Reference Looking DOWNSTREAM

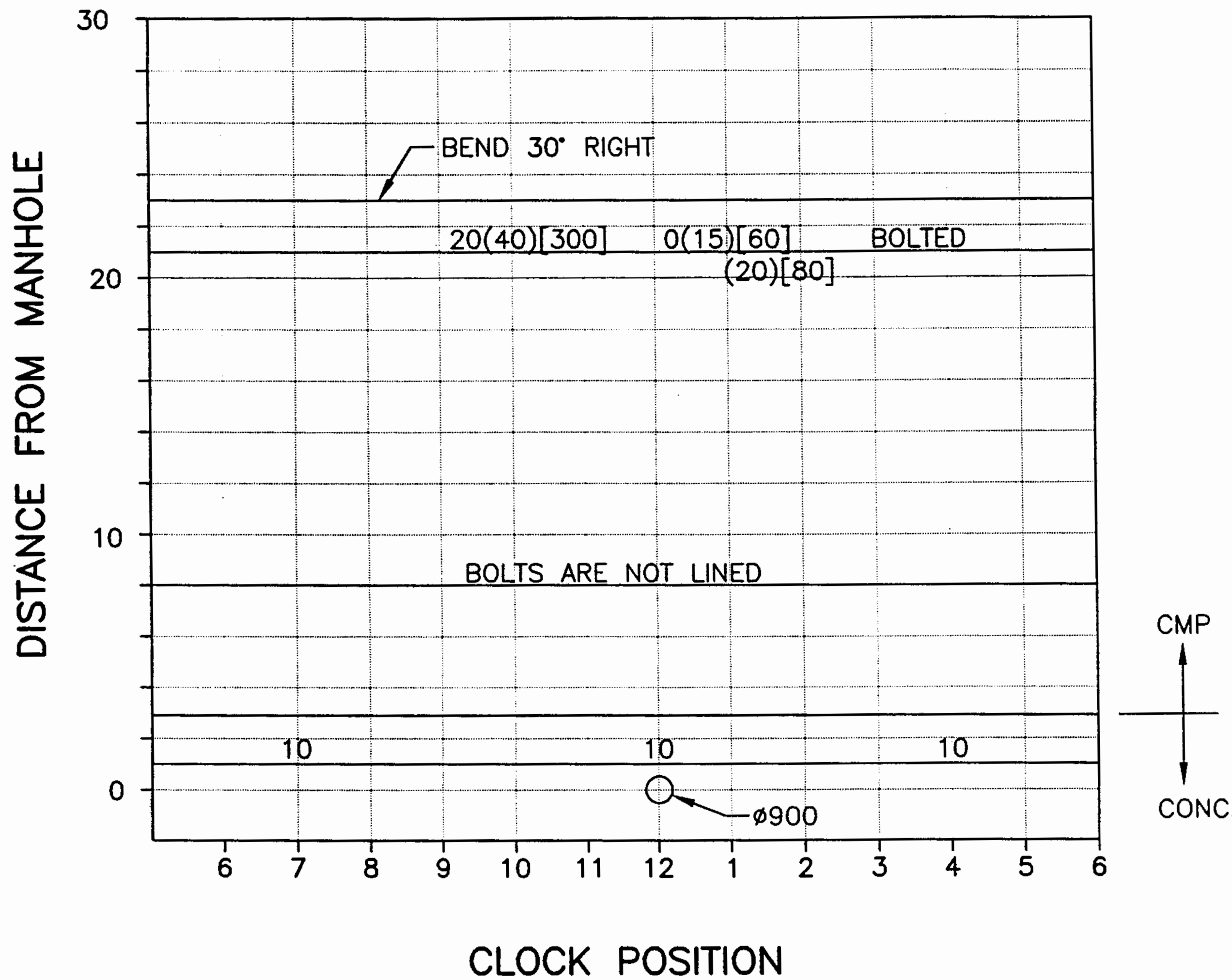
LEGEND:

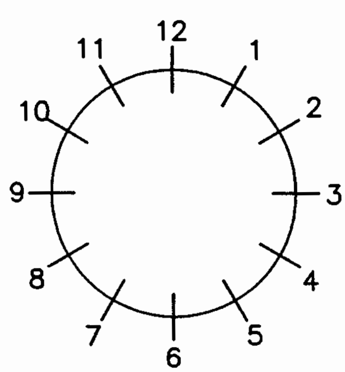
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	ST21	

KGS FILE NO.: 97-107-12ST21

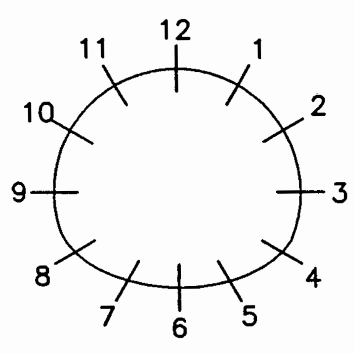
BUNN'S CREEK

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM

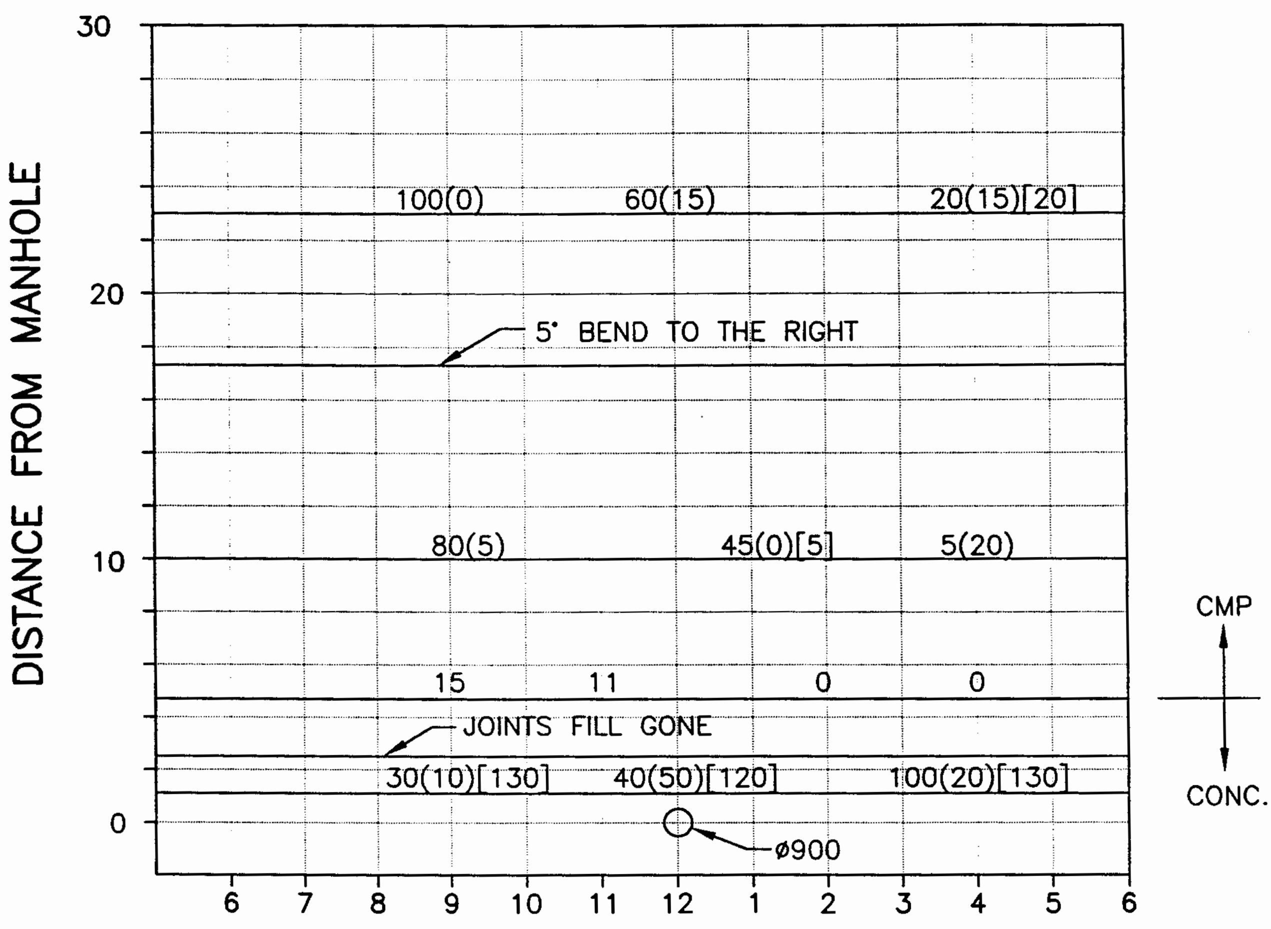


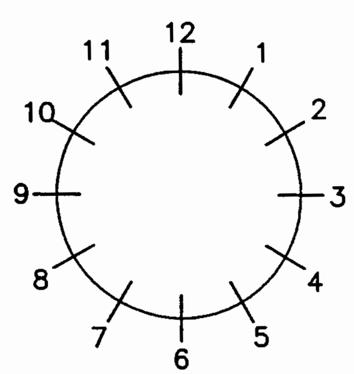
Clock Reference Looking DOWNSTREAM

LEGEND:

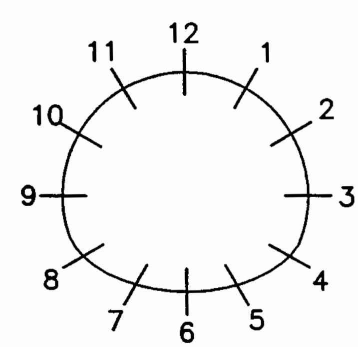
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	BU1	

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



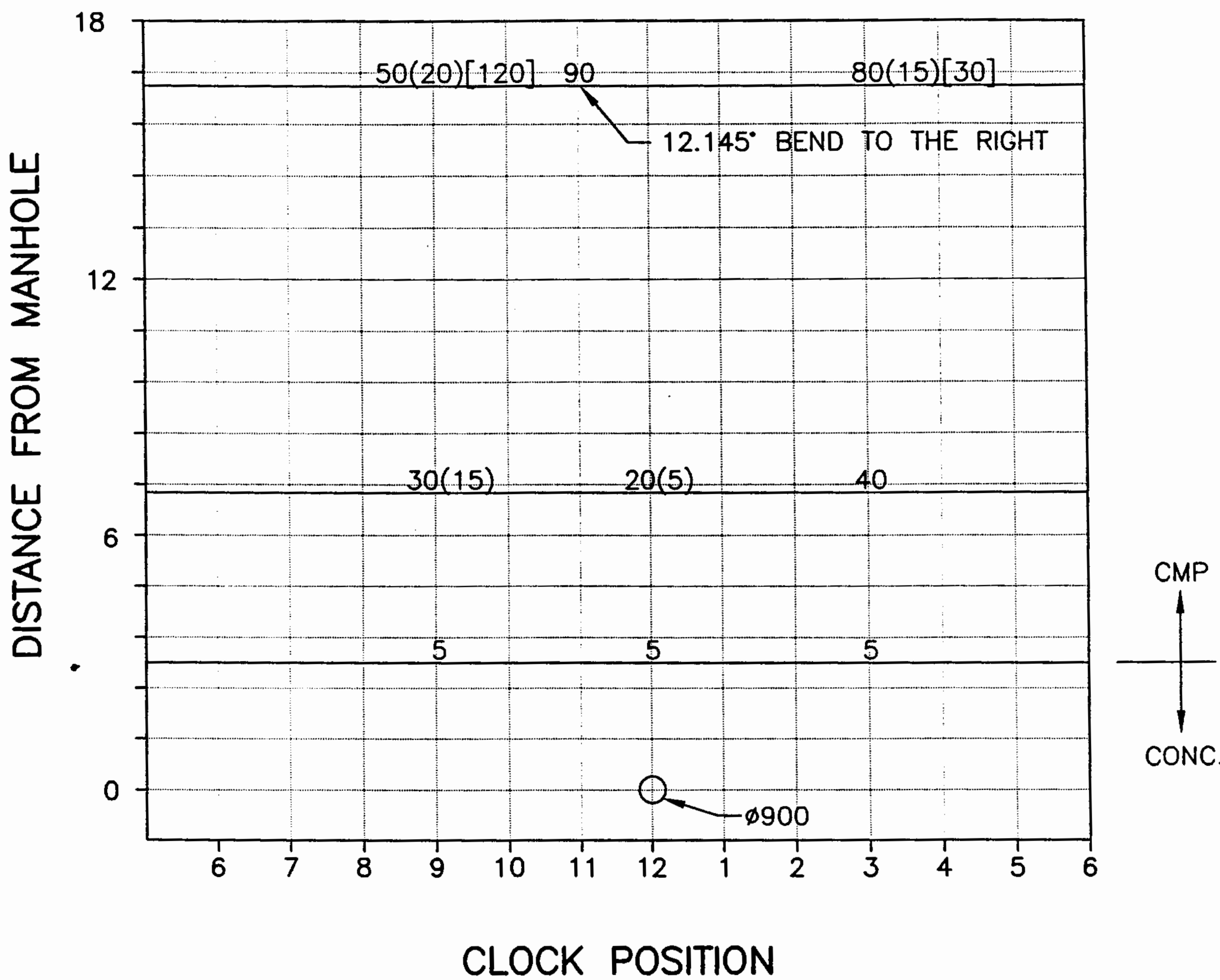
Clock Reference Looking DOWNSTREAM

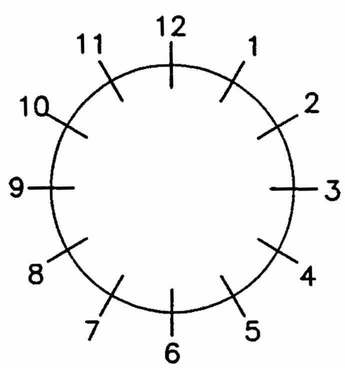
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	BU2	

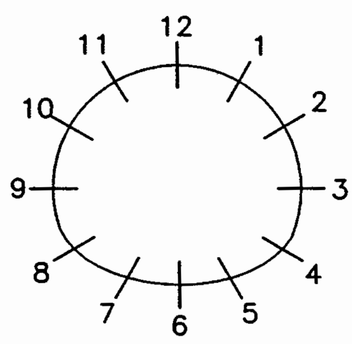
KGS FILE NO.: 97-107-12BU2

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



Clock Reference Looking
DOWNSTREAM

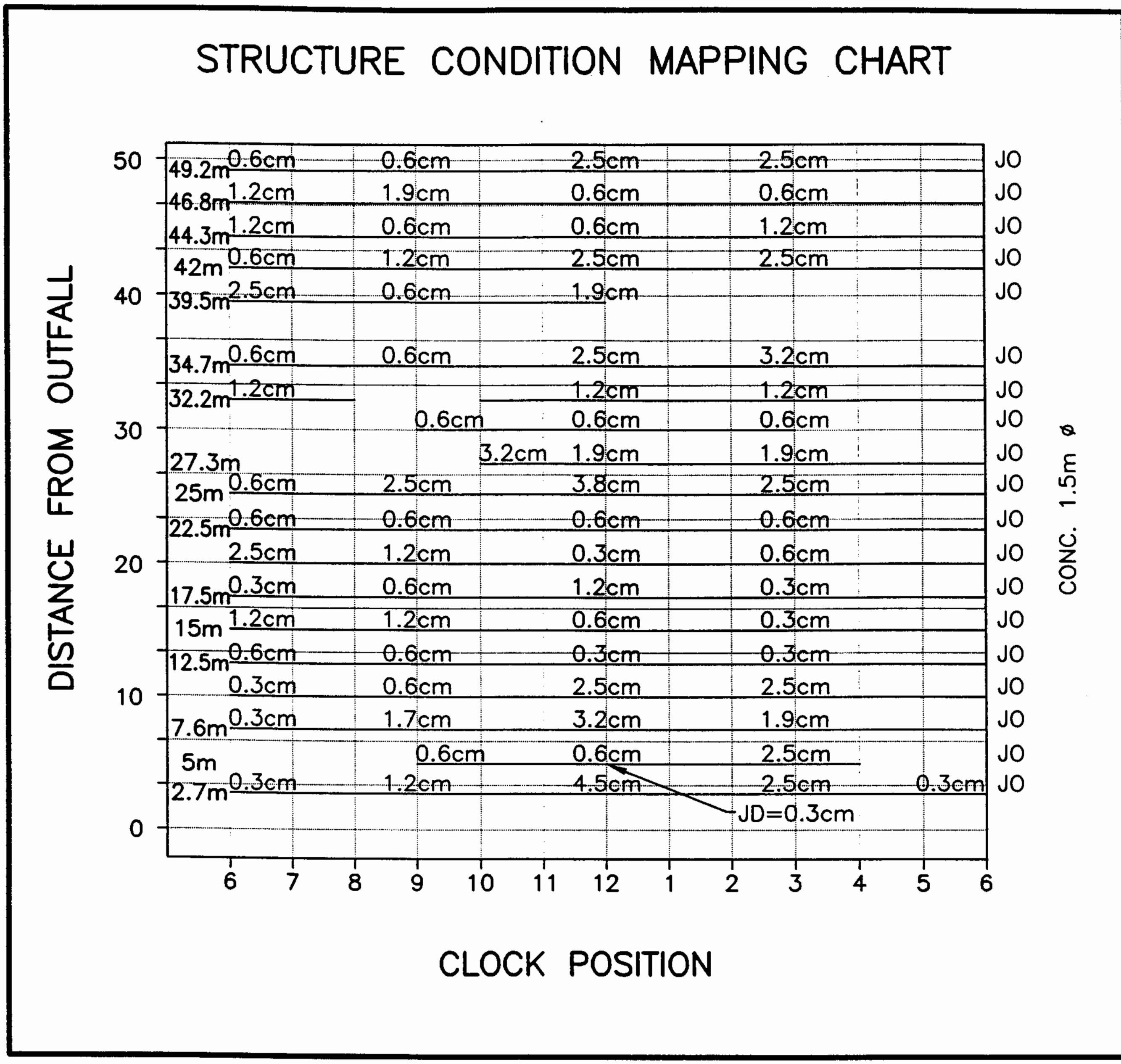
LEGEND:

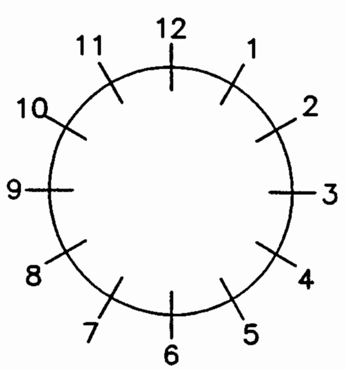
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	BU10	

KGS FILE NO.: 97-107-12BU10

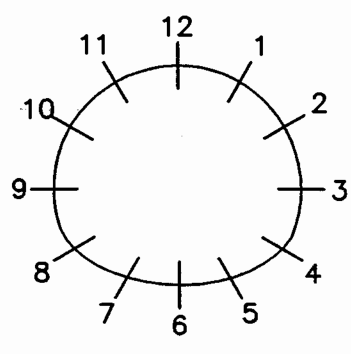
WINNIPEG FLOODWAY

PROPERTY
OF THE
WATER & WASTE DEPARTMENT
RESOURCE CENTRE
1500 PLESSIS ROAD





Clock Reference Looking
DOWNSTREAM



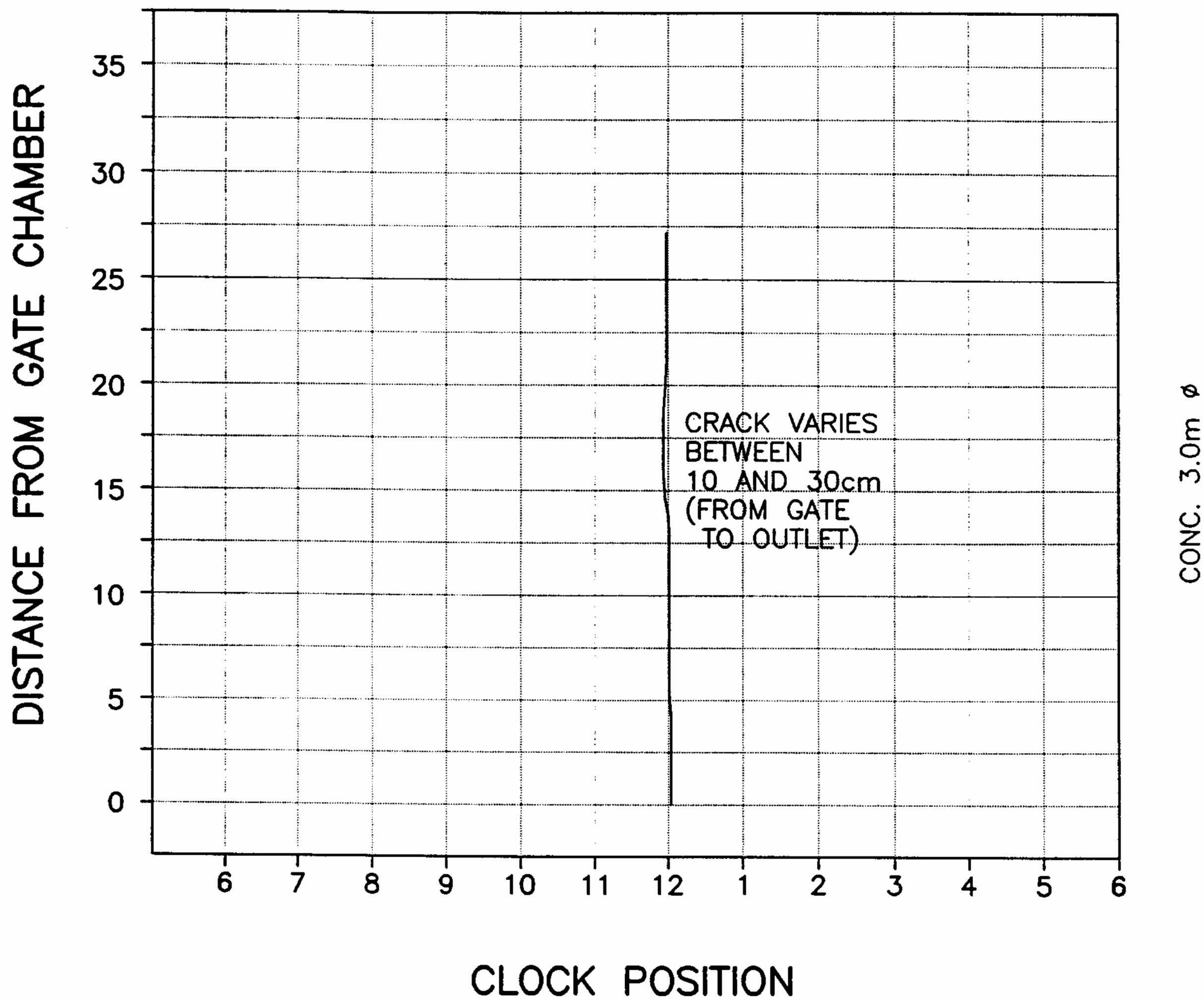
Clock Reference Looking
DOWNSTREAM

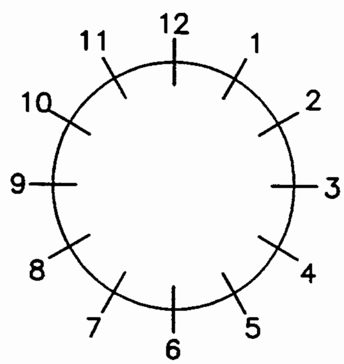
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	FL1	

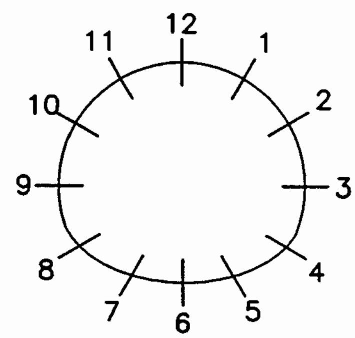
KGS FILE NO.: 97-107-12FL1

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



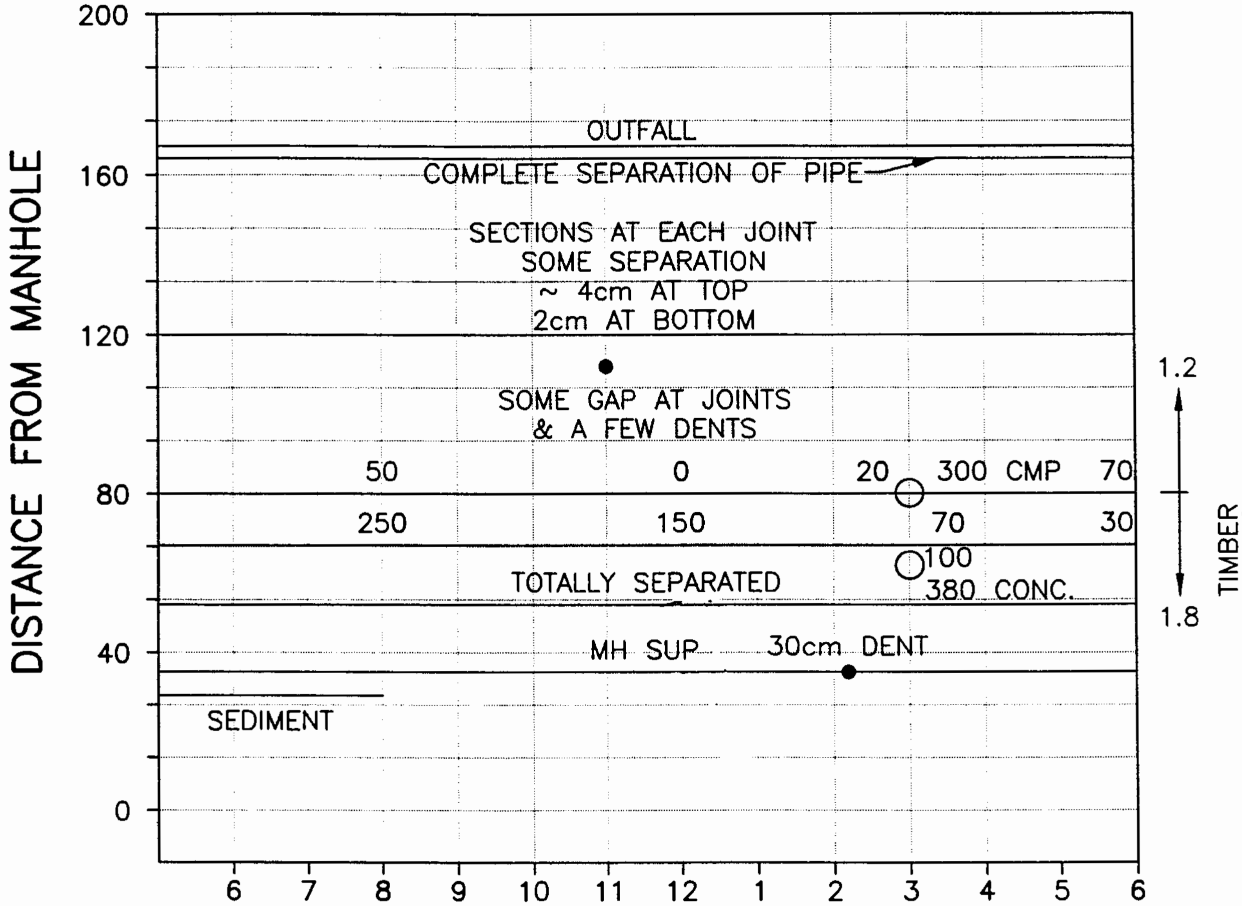
Clock Reference Looking DOWNSTREAM

LEGEND:

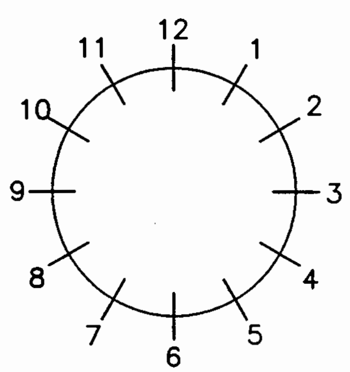
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	FL2	

KGS FILE NO.: 97-107-12FL2

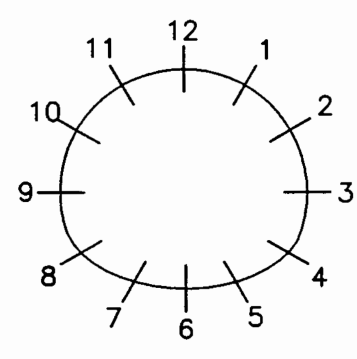
STRUCTURE CONDITION MAPPING CHART



CLOCK POSITION



Clock Reference Looking
DOWNSTREAM



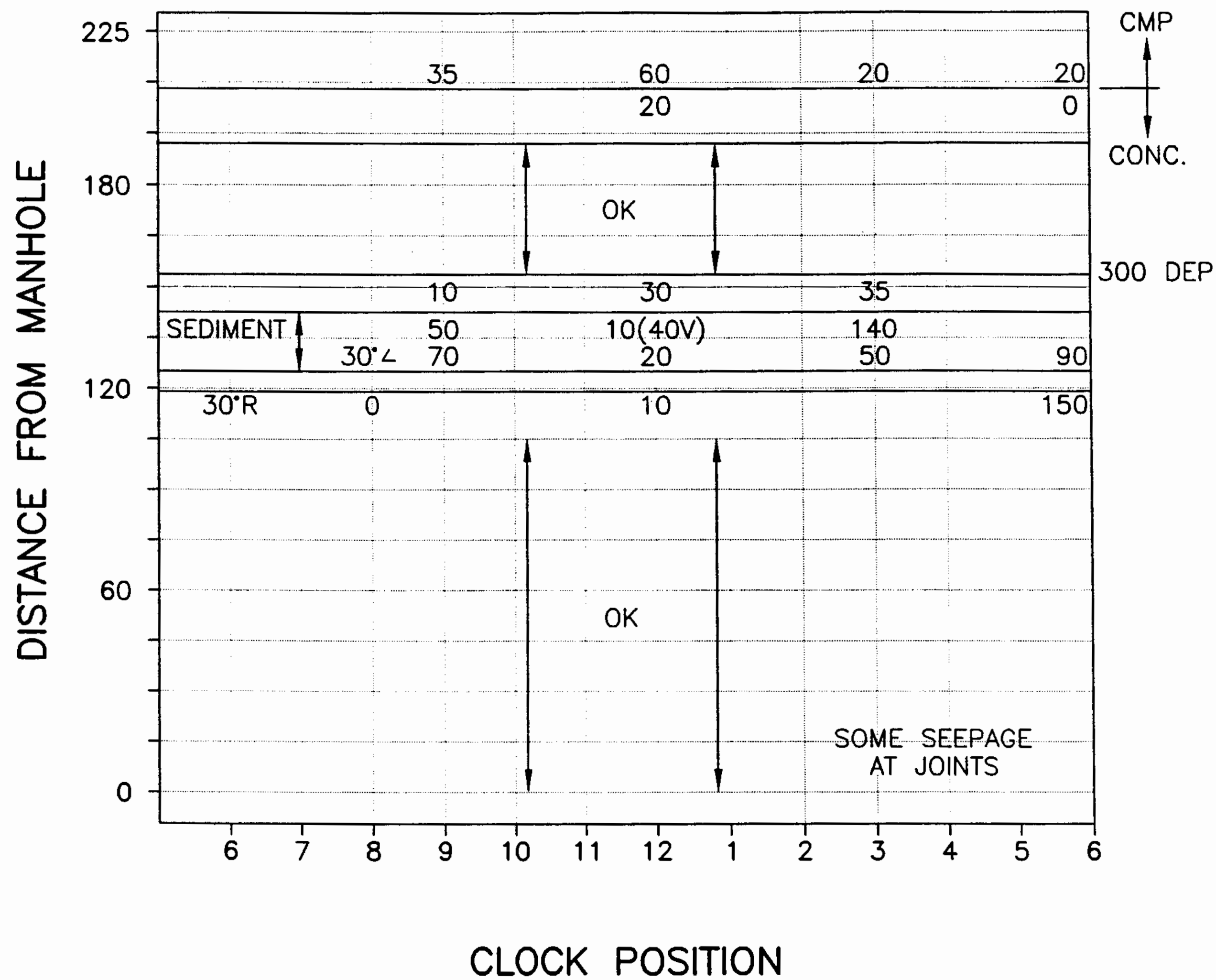
Clock Reference Looking
DOWNSTREAM

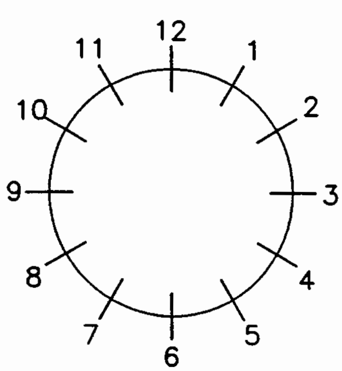
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R7	

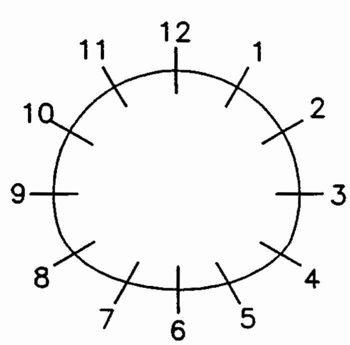
KGS FILE NO.: 97-107-12R7

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



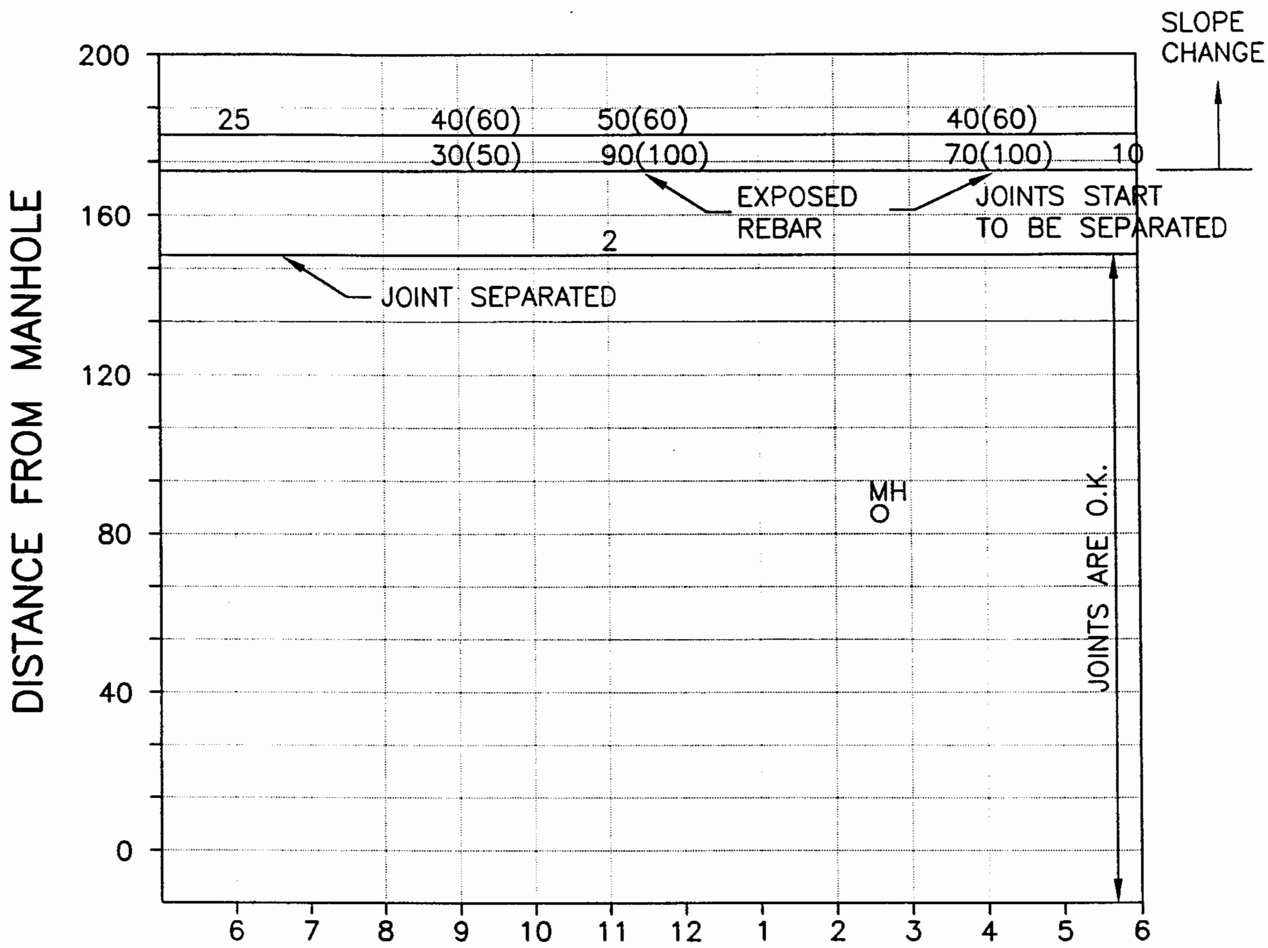
Clock Reference Looking
DOWNSTREAM

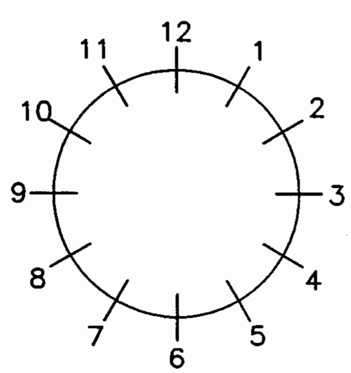
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R9	

KGS FILE NO.: 97–107–12R9

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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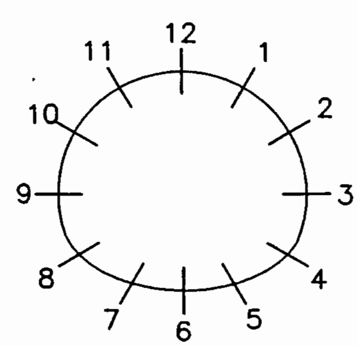


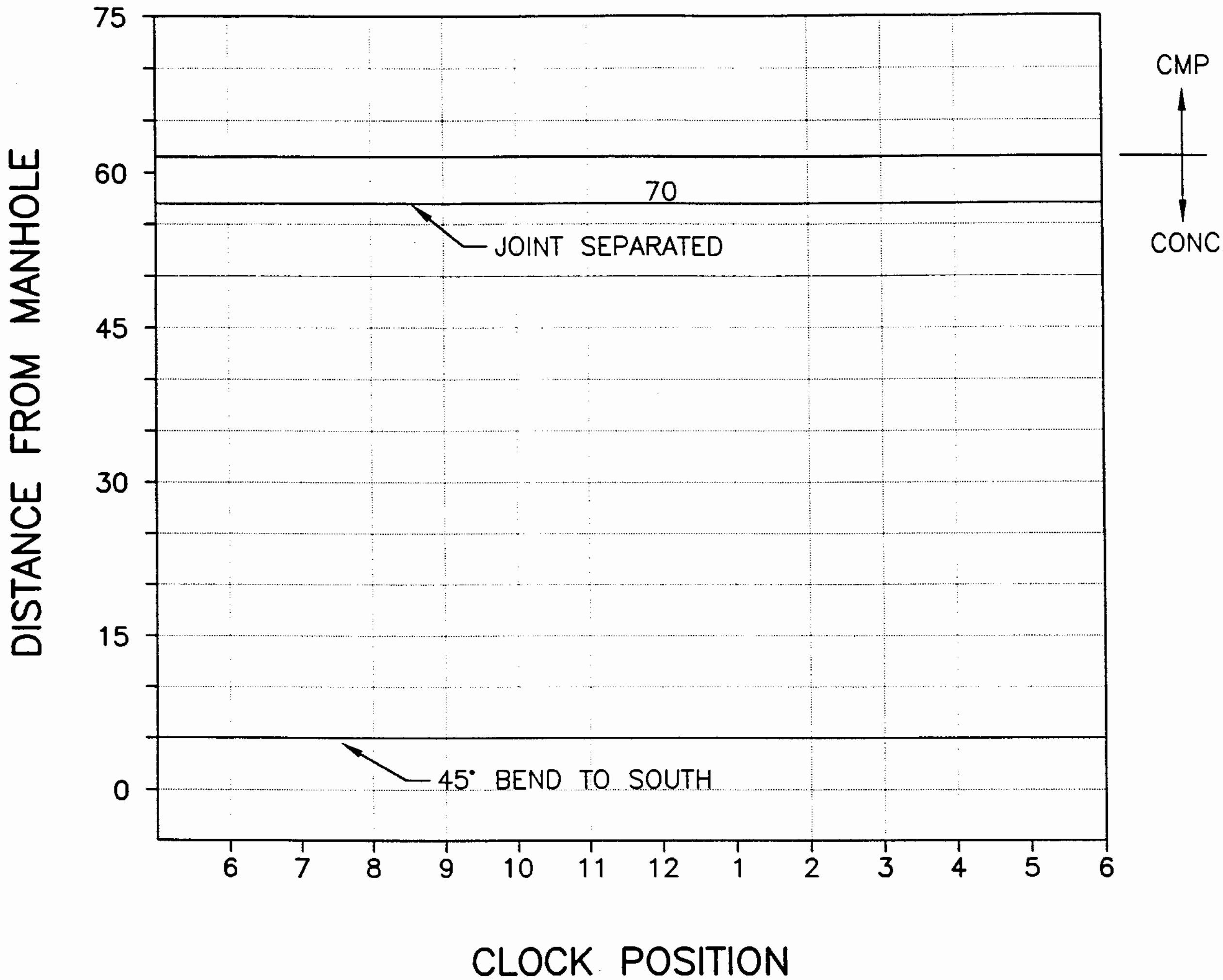
Clock Reference Looking
DOWNSTREAM

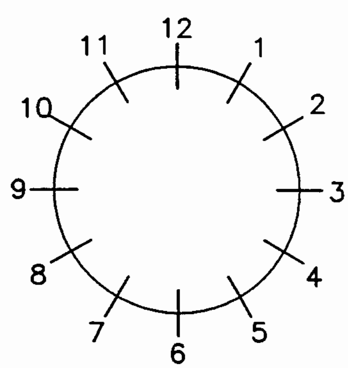
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R10	

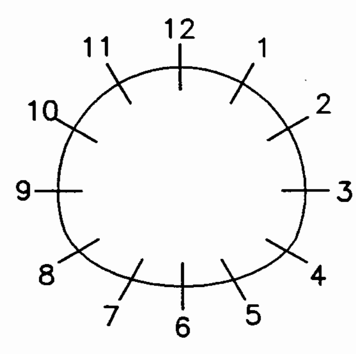
KGS FILE NO.: 97-107-12R10

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM

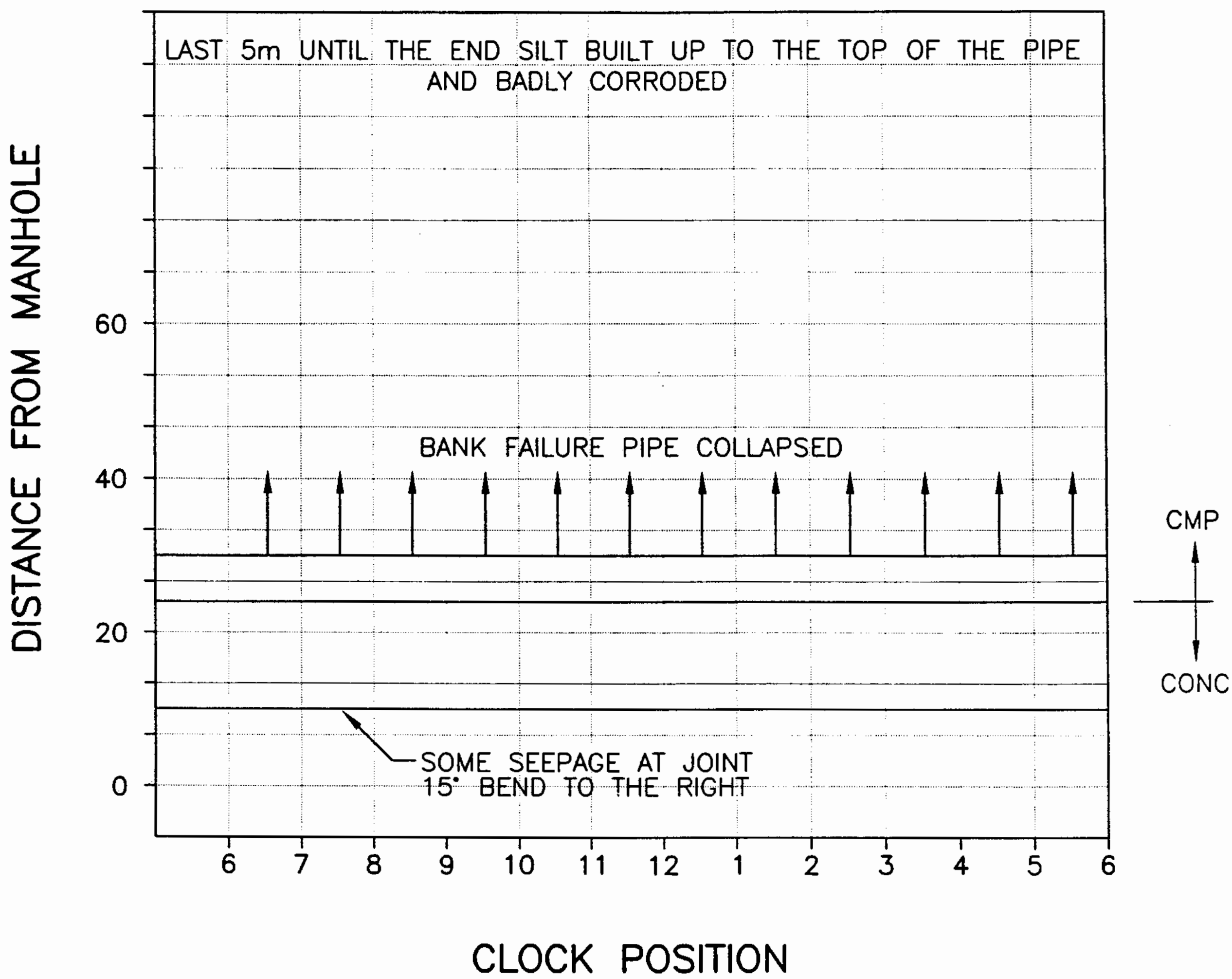


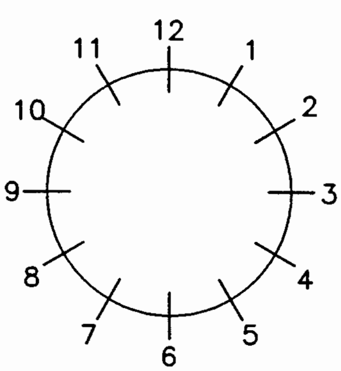
Clock Reference Looking DOWNSTREAM

LEGEND:

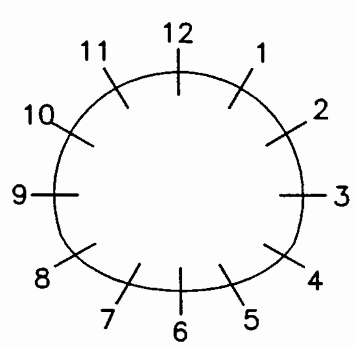
DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R12	

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



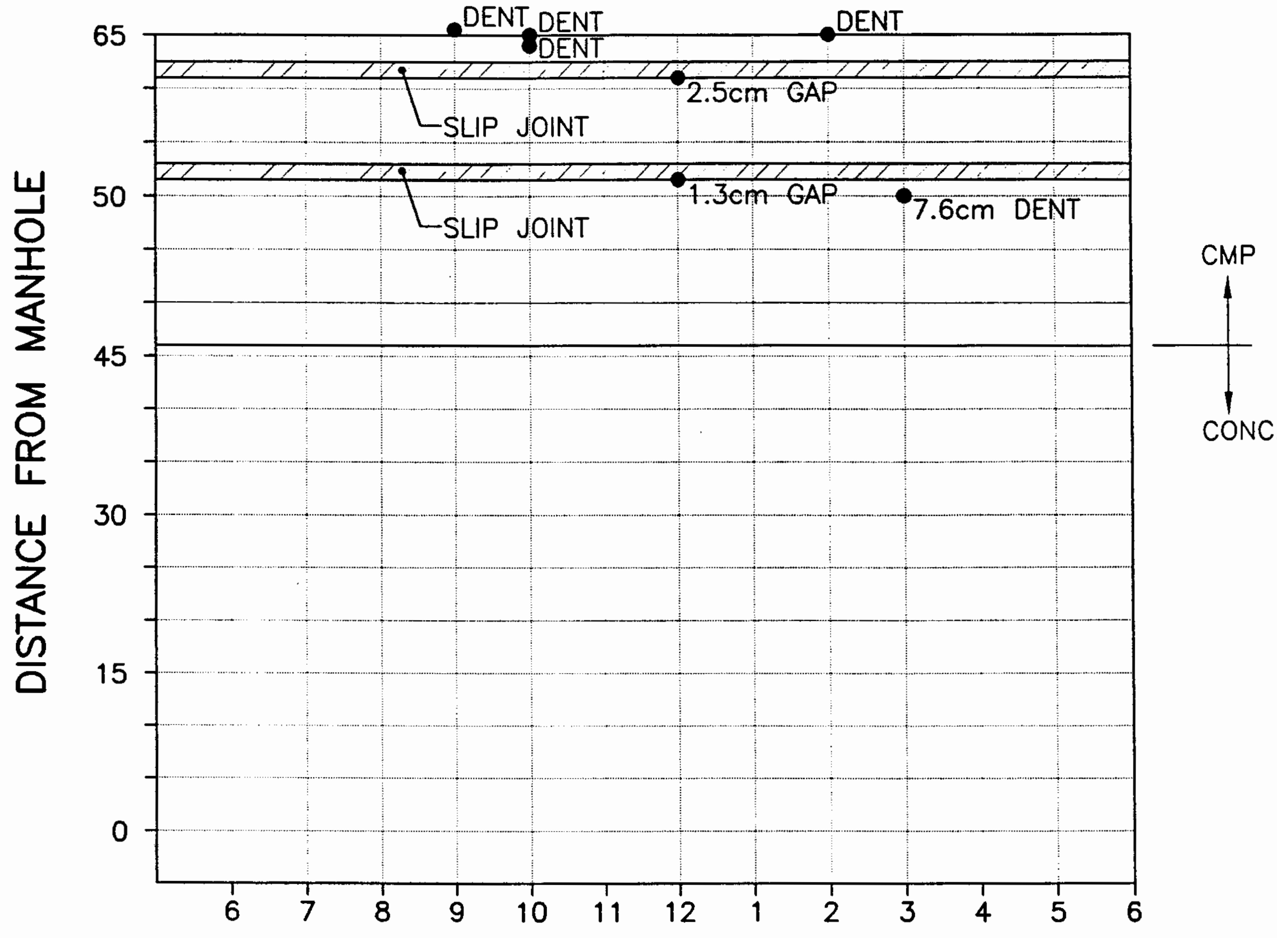
Clock Reference Looking DOWNSTREAM

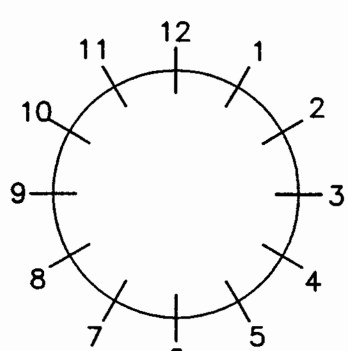
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Open	JO
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R15	

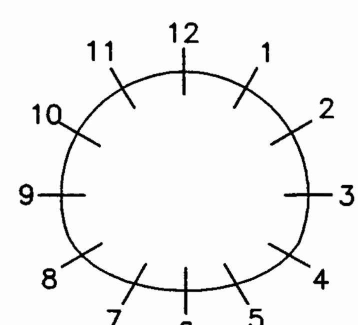
KGS FILE NO.: 97-107-12R15

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



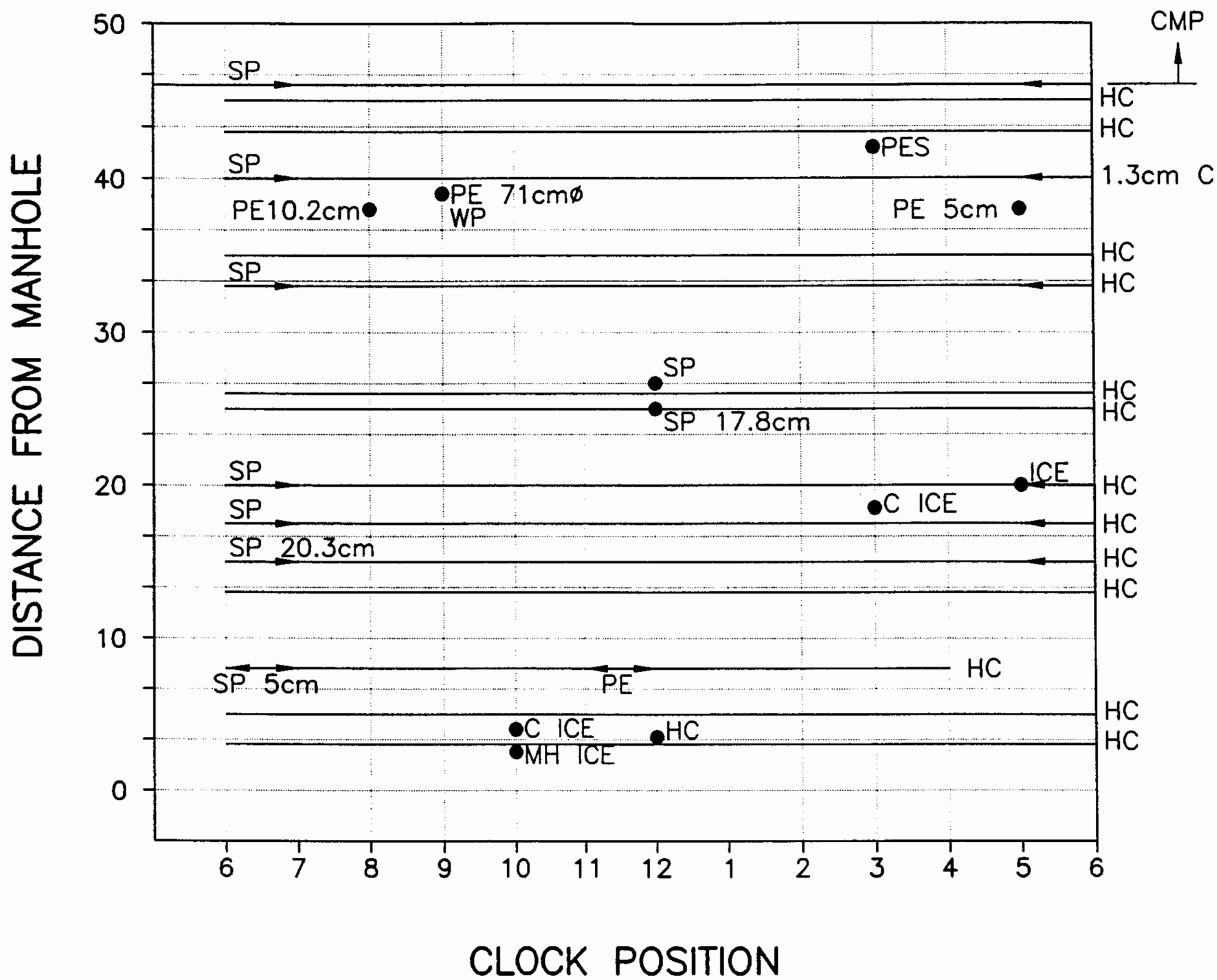
Clock Reference Looking
DOWNSTREAM

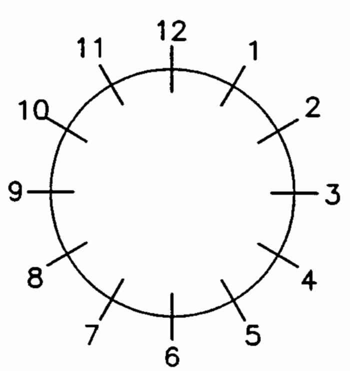
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R17A	

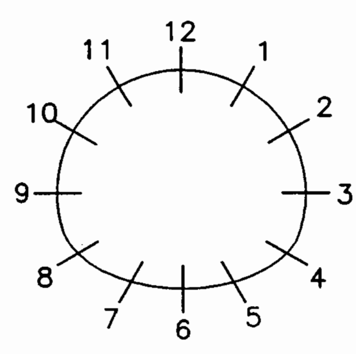
KGS FILE NO.: 97-107-12R17

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



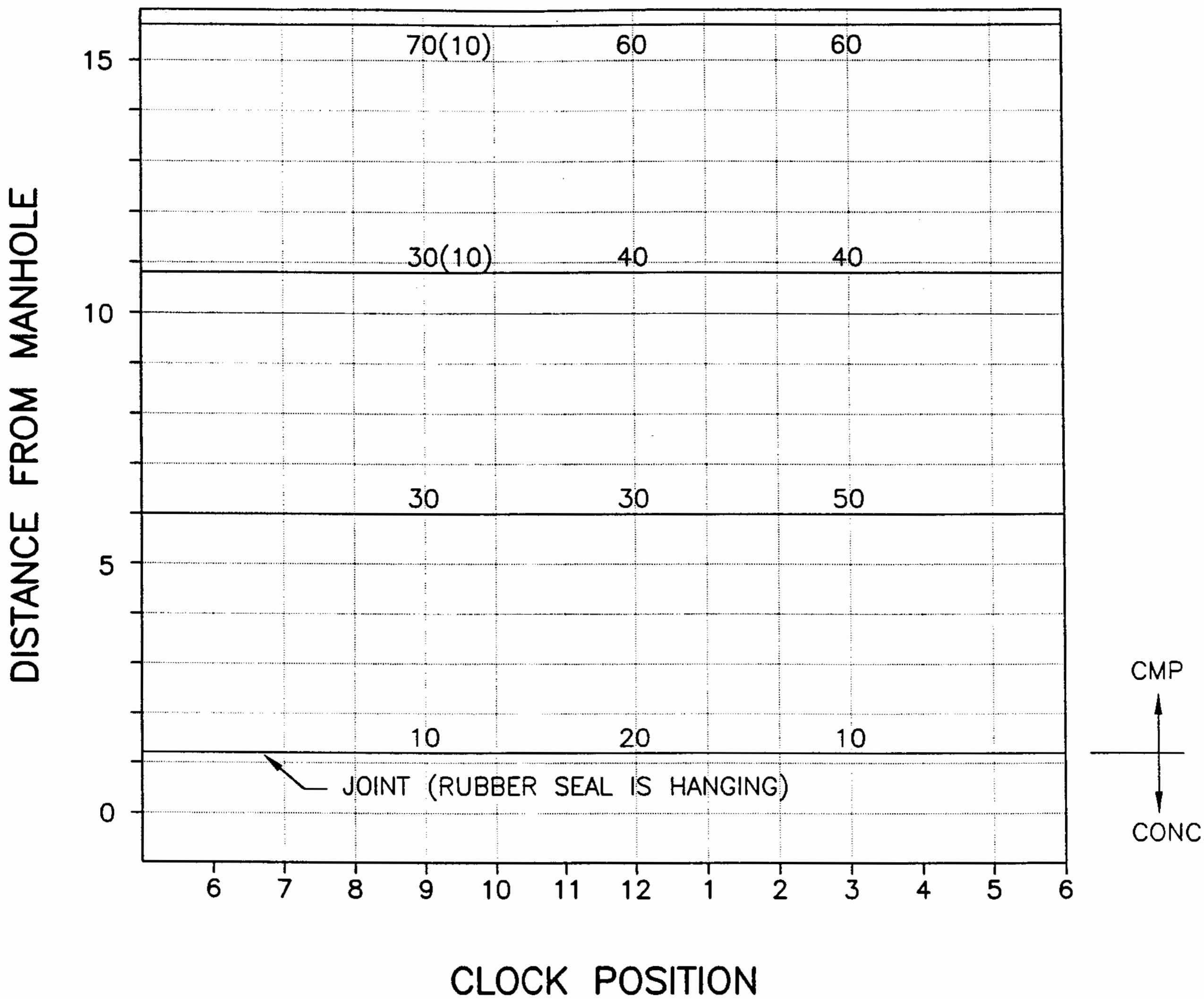
Clock Reference Looking DOWNSTREAM

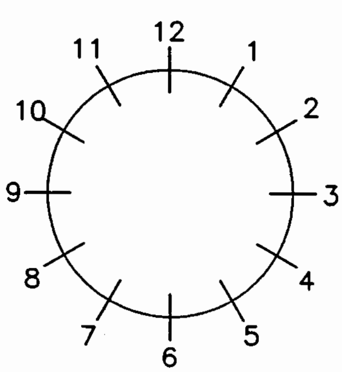
LEGEND:

DEFECTIVE CONCRETE:		Spalling	SP	JOINTS:	Spalled	SP
Water Seepage	WP	Cracked	C		Displaced	JD
Manhole	MH	Pipe Entrance	PE		Spalled	SP
Seepage	S	Pipe Entrance Sealed	PES	PIPE IDENTIFICATION:	R17B	

KGS FILE NO.: 97-107-12R17

STRUCTURE CONDITION MAPPING CHART





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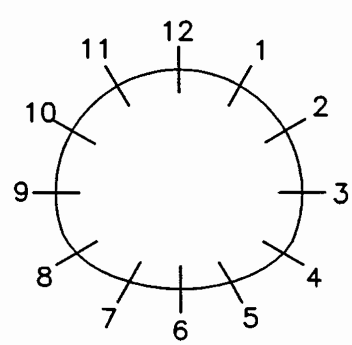


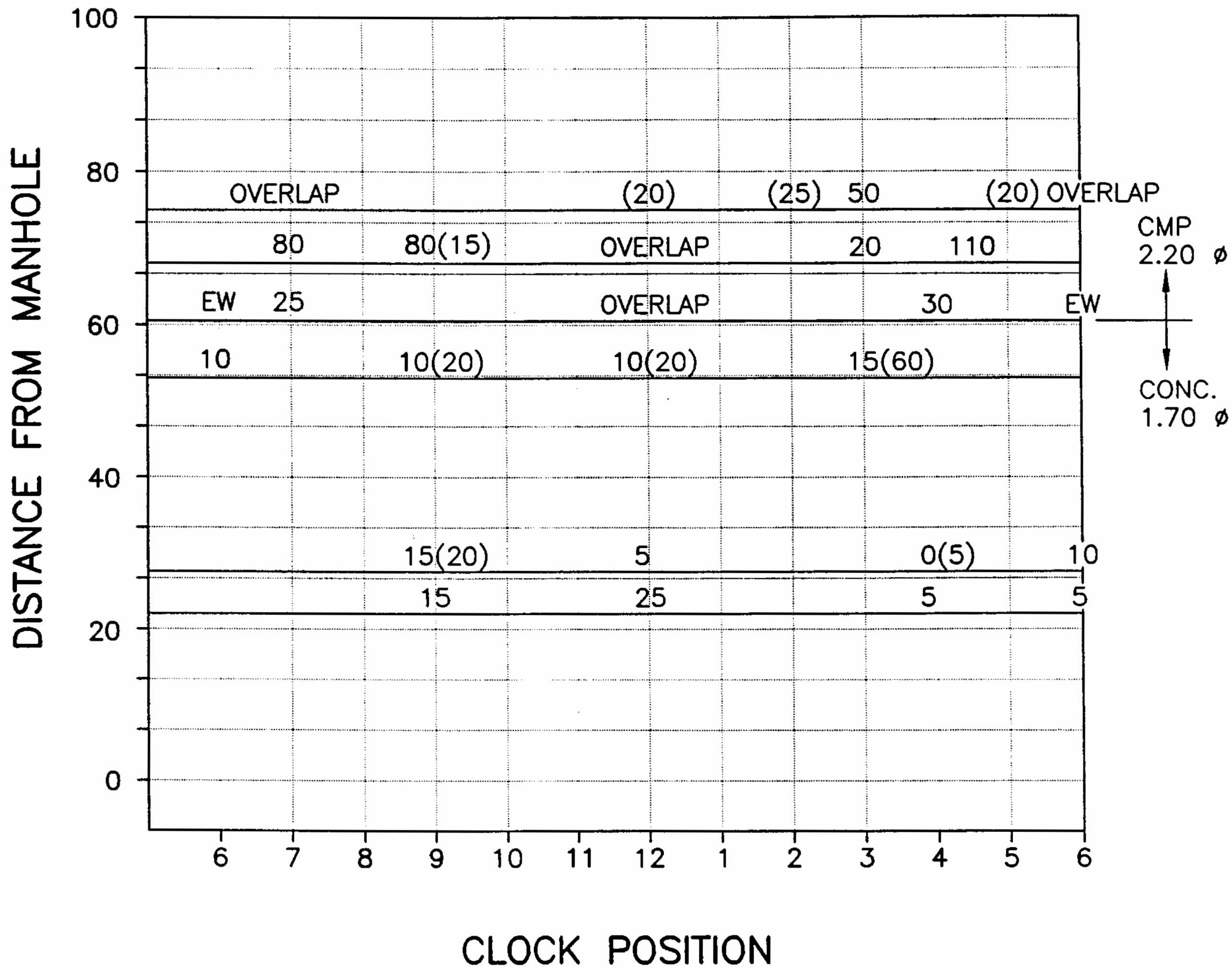
Clock Reference Looking DOWNSTREAM

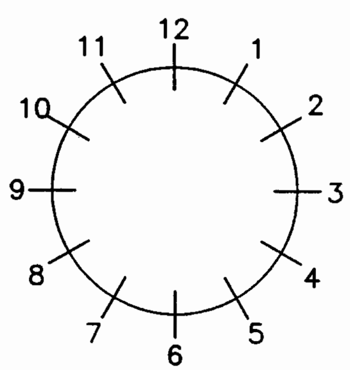
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R19	

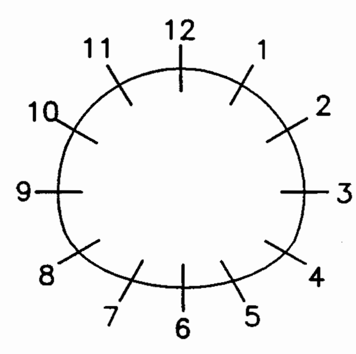
KGS FILE NO.: 97-107-12R19

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



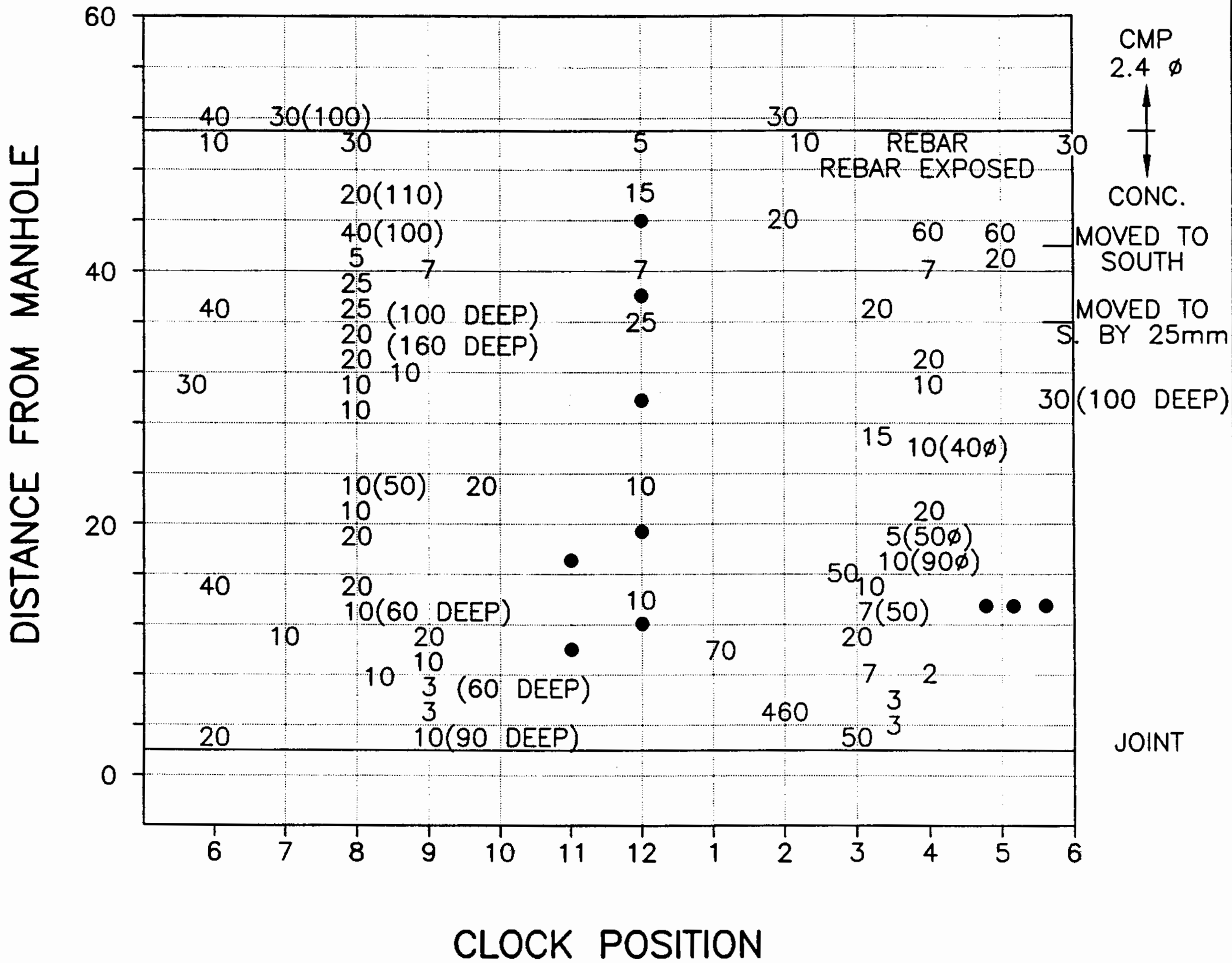
Clock Reference Looking
DOWNSTREAM

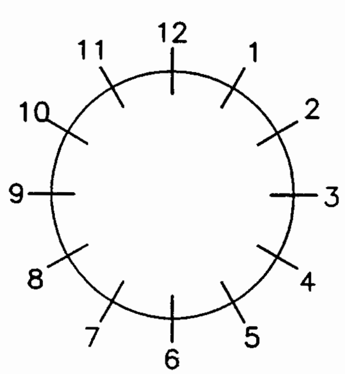
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R20	

KCS FILE NO.: 97-107-12R20

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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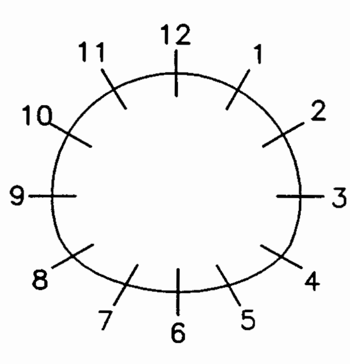


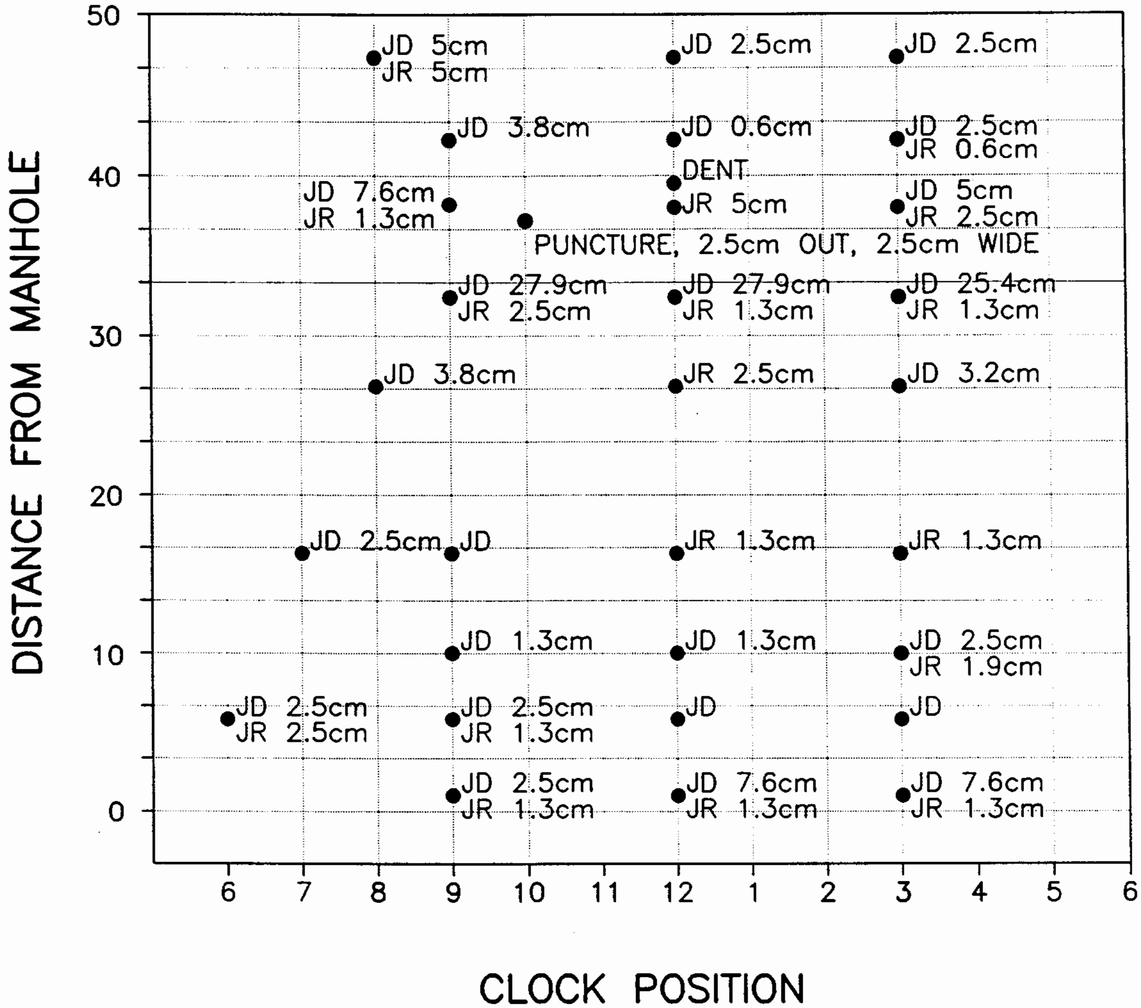
Clock Reference Looking
DOWNSTREAM

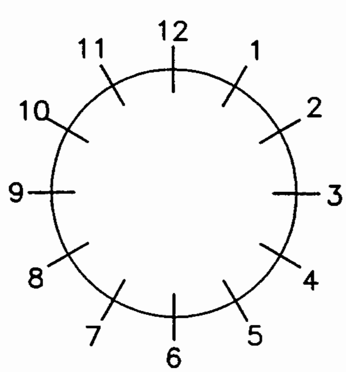
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R22	

KGS FILE NO.: 97-107-12R22

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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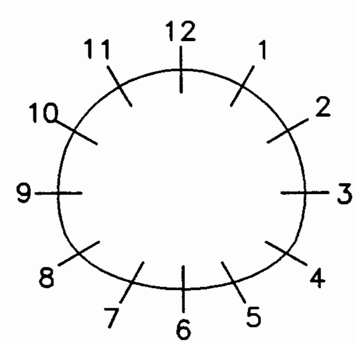


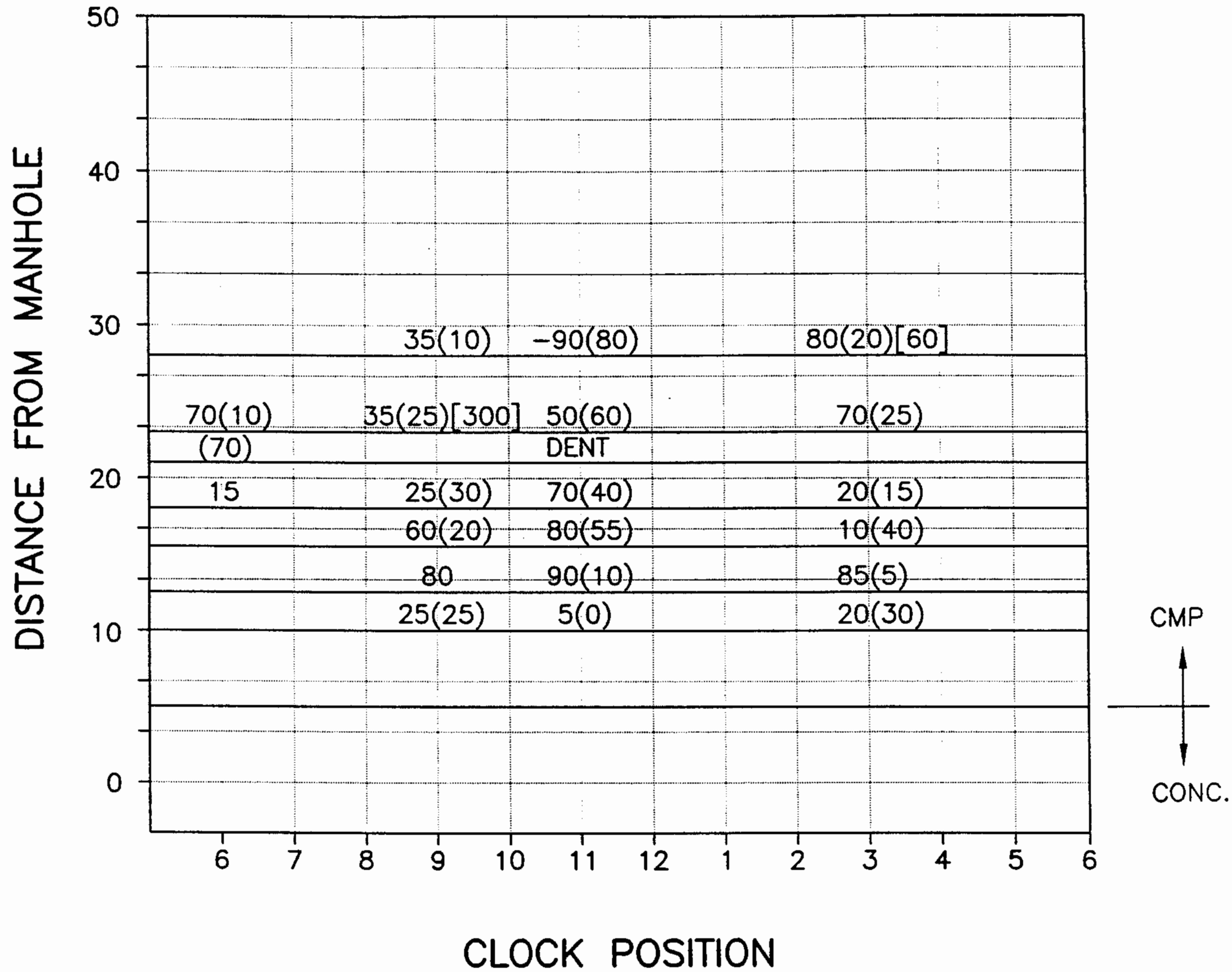
Clock Reference Looking
DOWNSTREAM

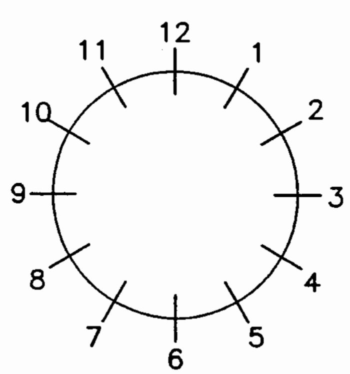
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R25	

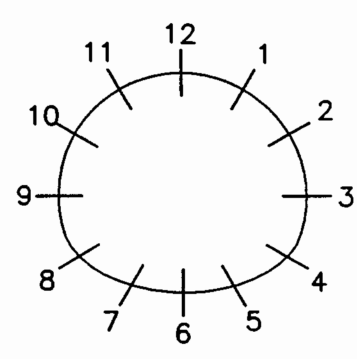
KGS FILE NO.: 97-107-12R25

STRUCTURE CONDITION MAPPING CHART





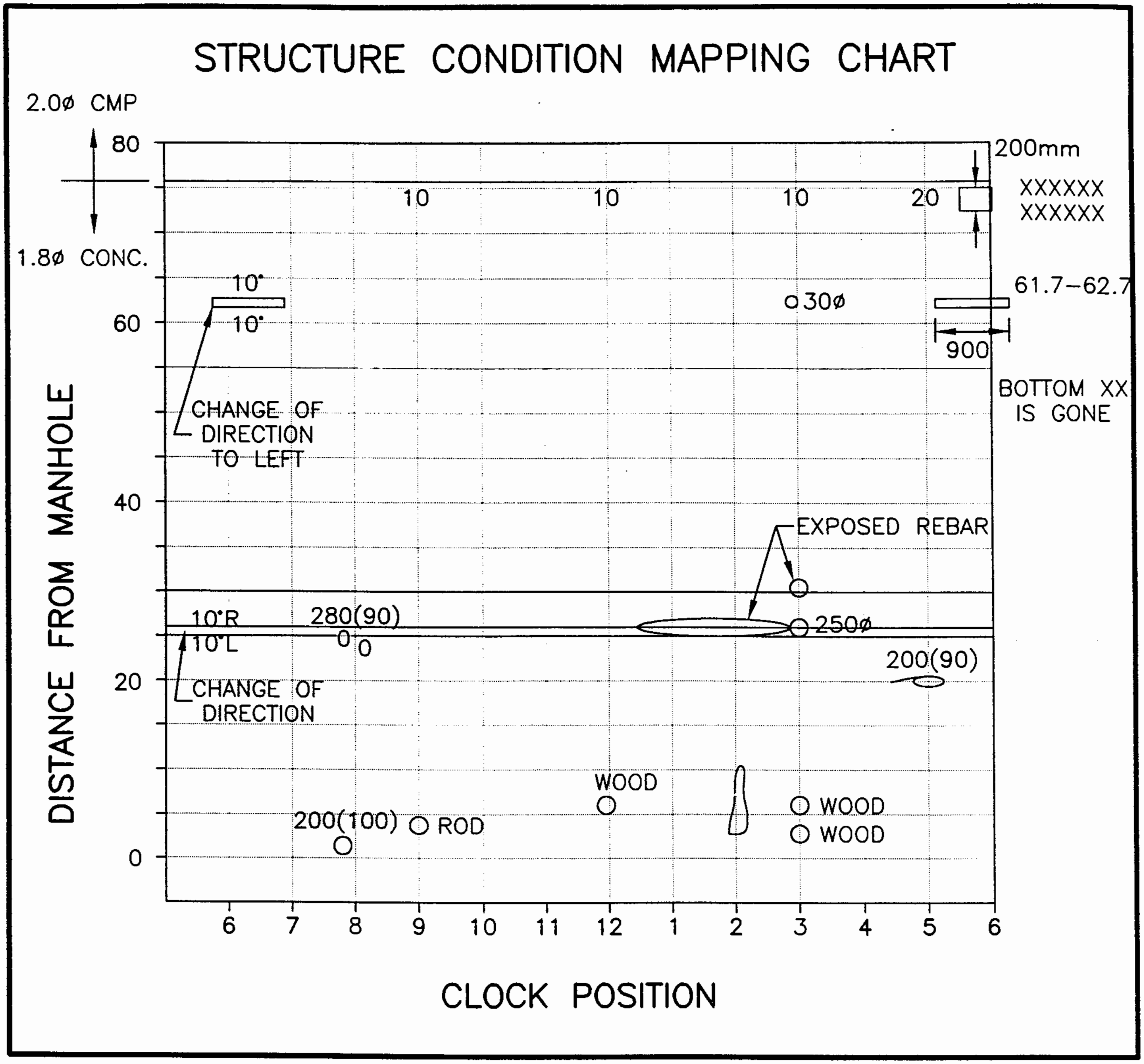
Clock Reference Looking DOWNSTREAM

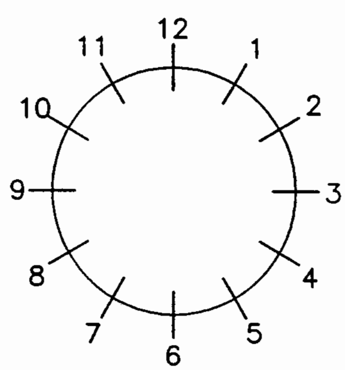


Clock Reference Looking DOWNSTREAM

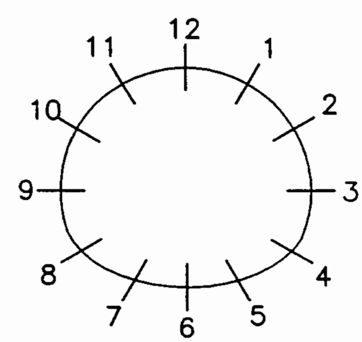
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R31	





Clock Reference Looking
DOWNSTREAM



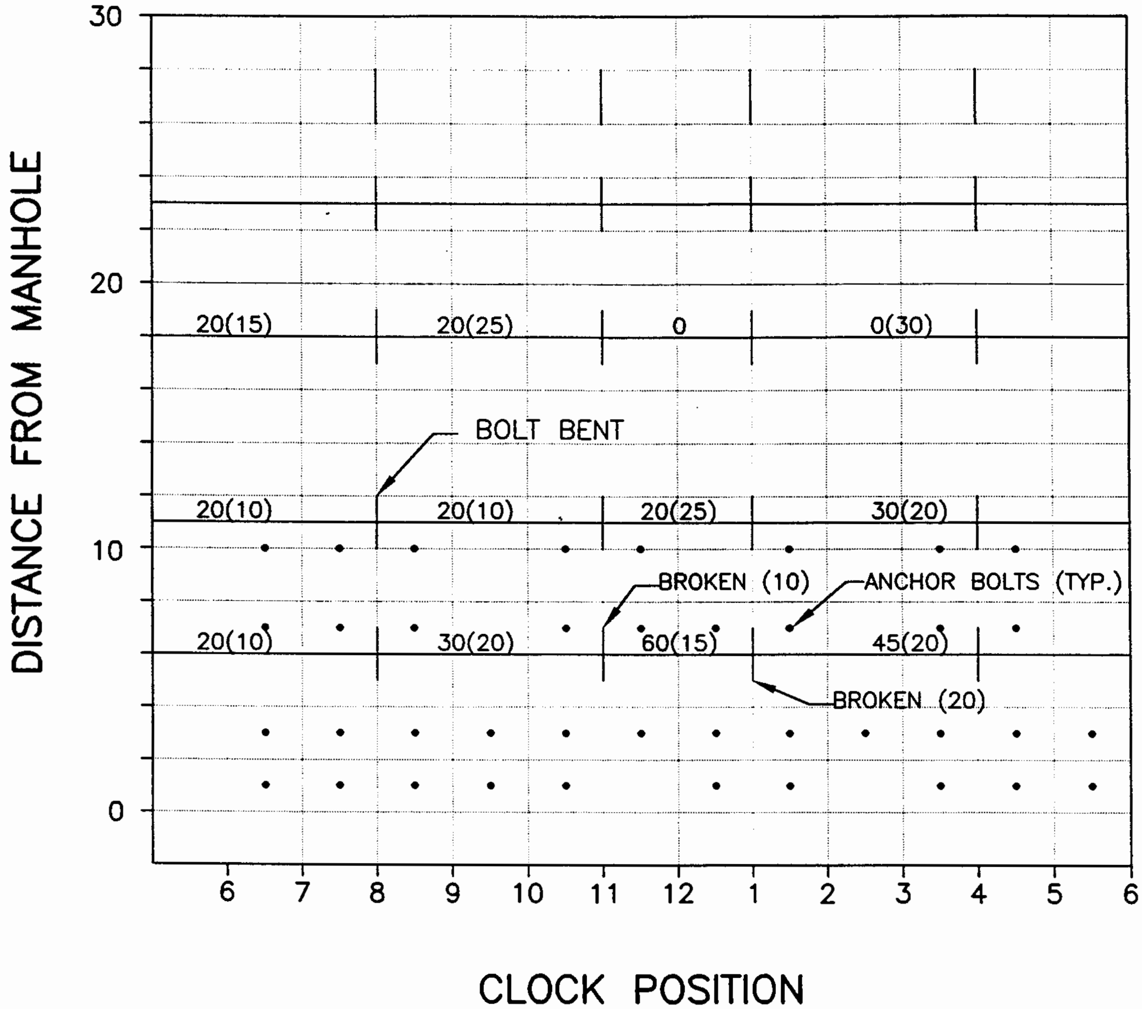
Clock Reference Looking
DOWNSTREAM

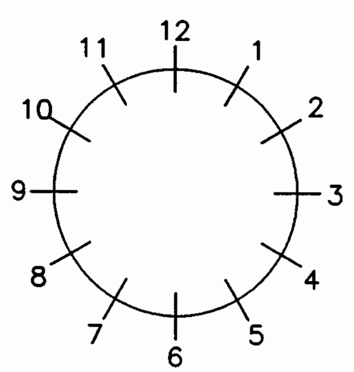
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R36	

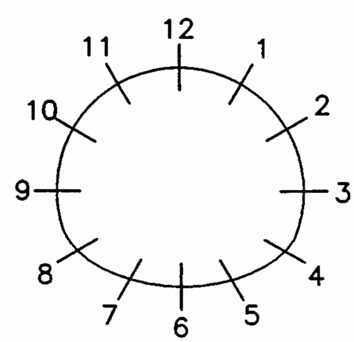
KCS FILE NO.: 97-107-1234

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



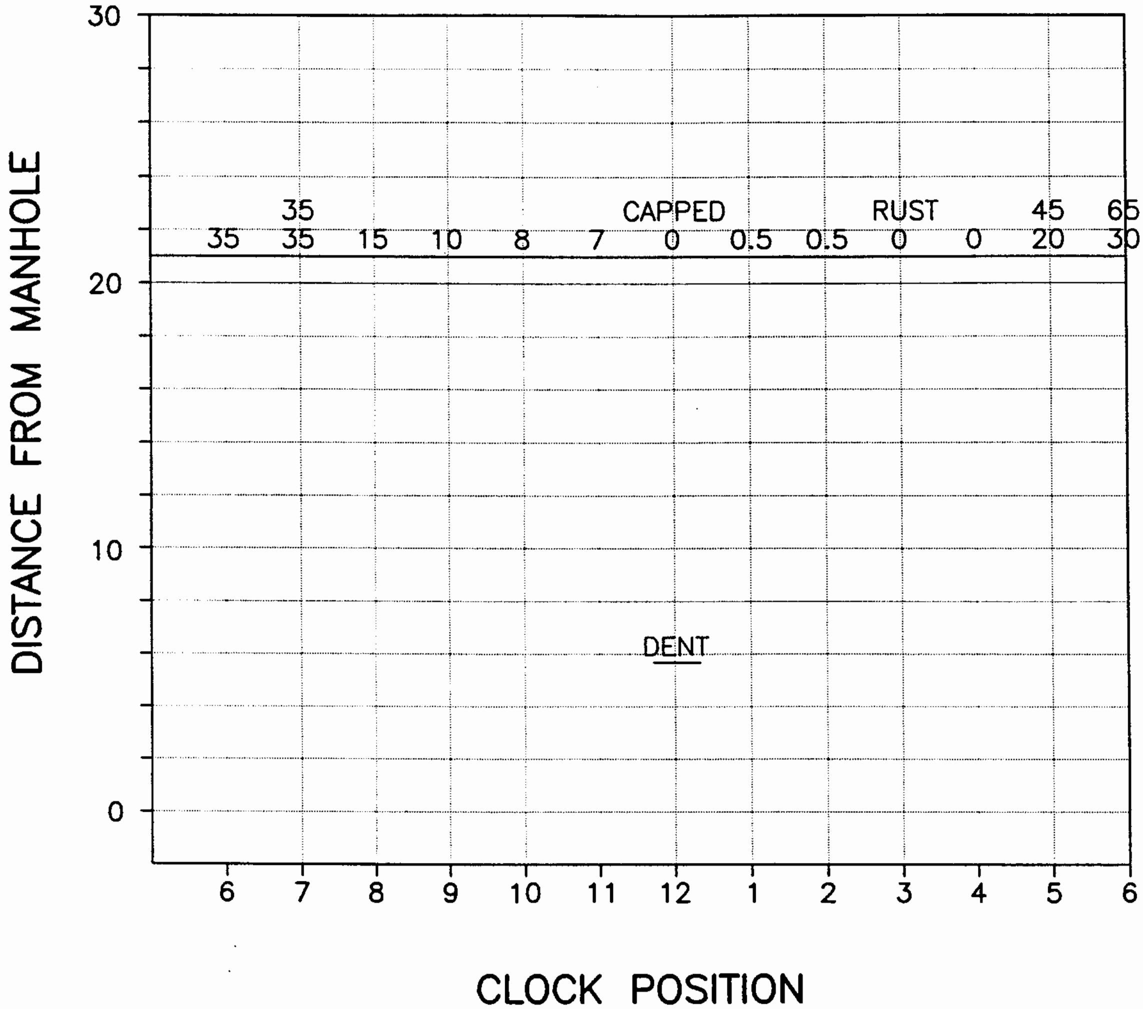
Clock Reference Looking
DOWNSTREAM

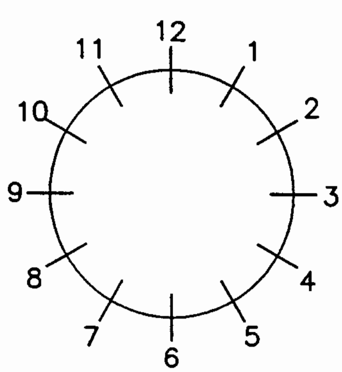
LEGEND:

DEFECTIVE CONCRETE:			JOINTS:		
• ANCHOR BOLT	Spalling	SP		Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R38	

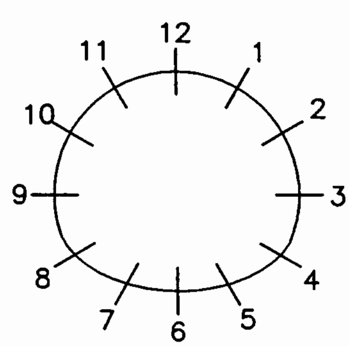
KGS FILE NO.: 97-107-12R38

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM

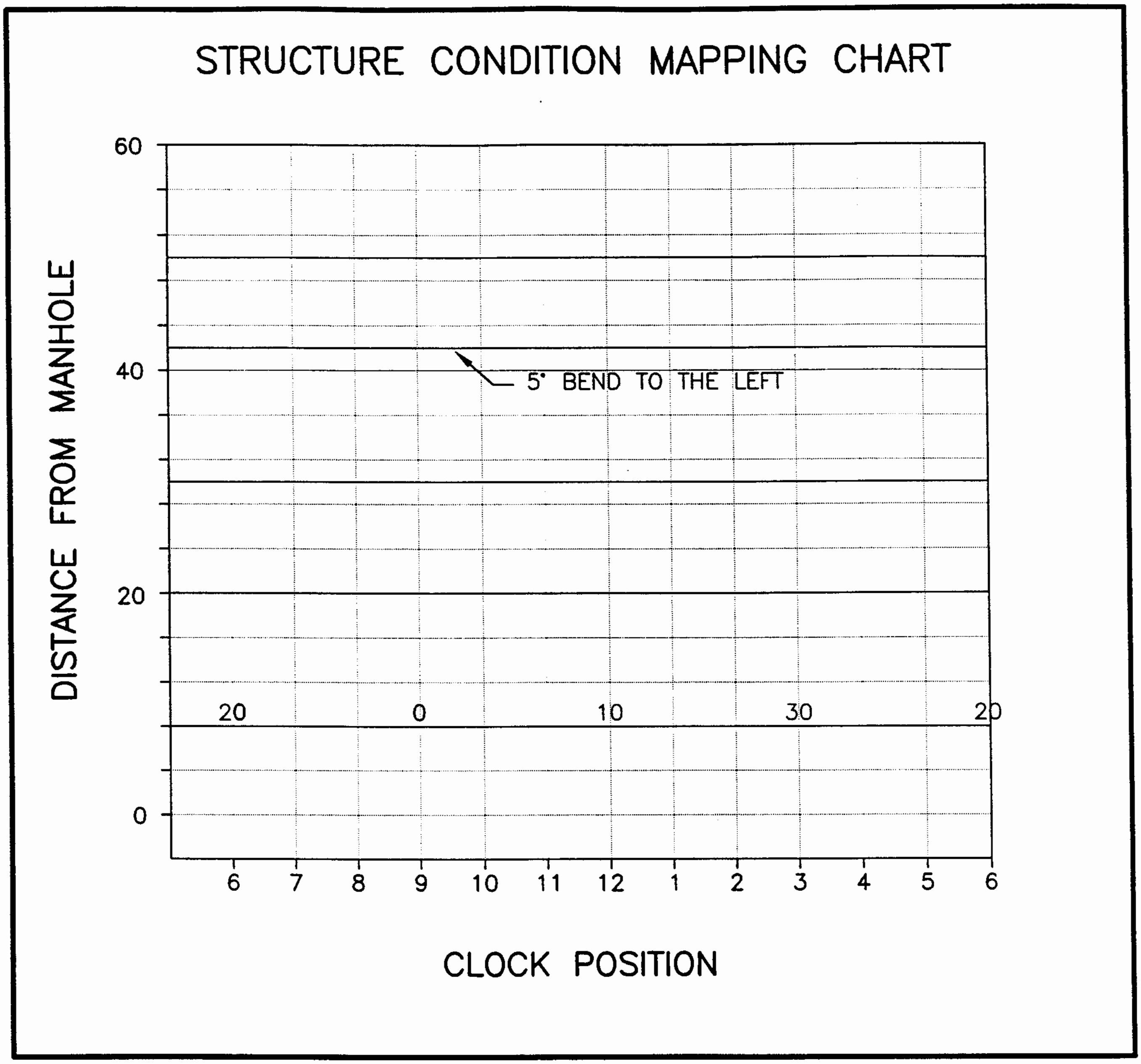


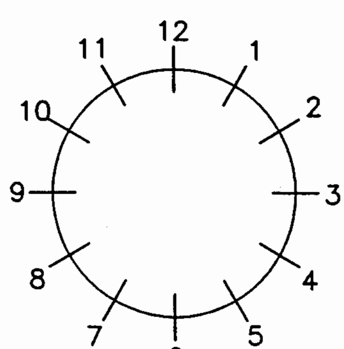
Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling Honeycomb Erosion/Wear Delaminated	SP HC EW DC	JOINTS: PIPE IDENTIFICATION:	Raised Displaced Spalled R39	JR JD SP

KGS FILE NO.: 97-107-12R39





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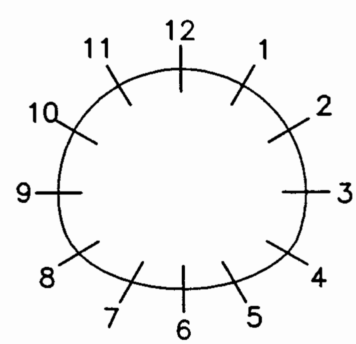


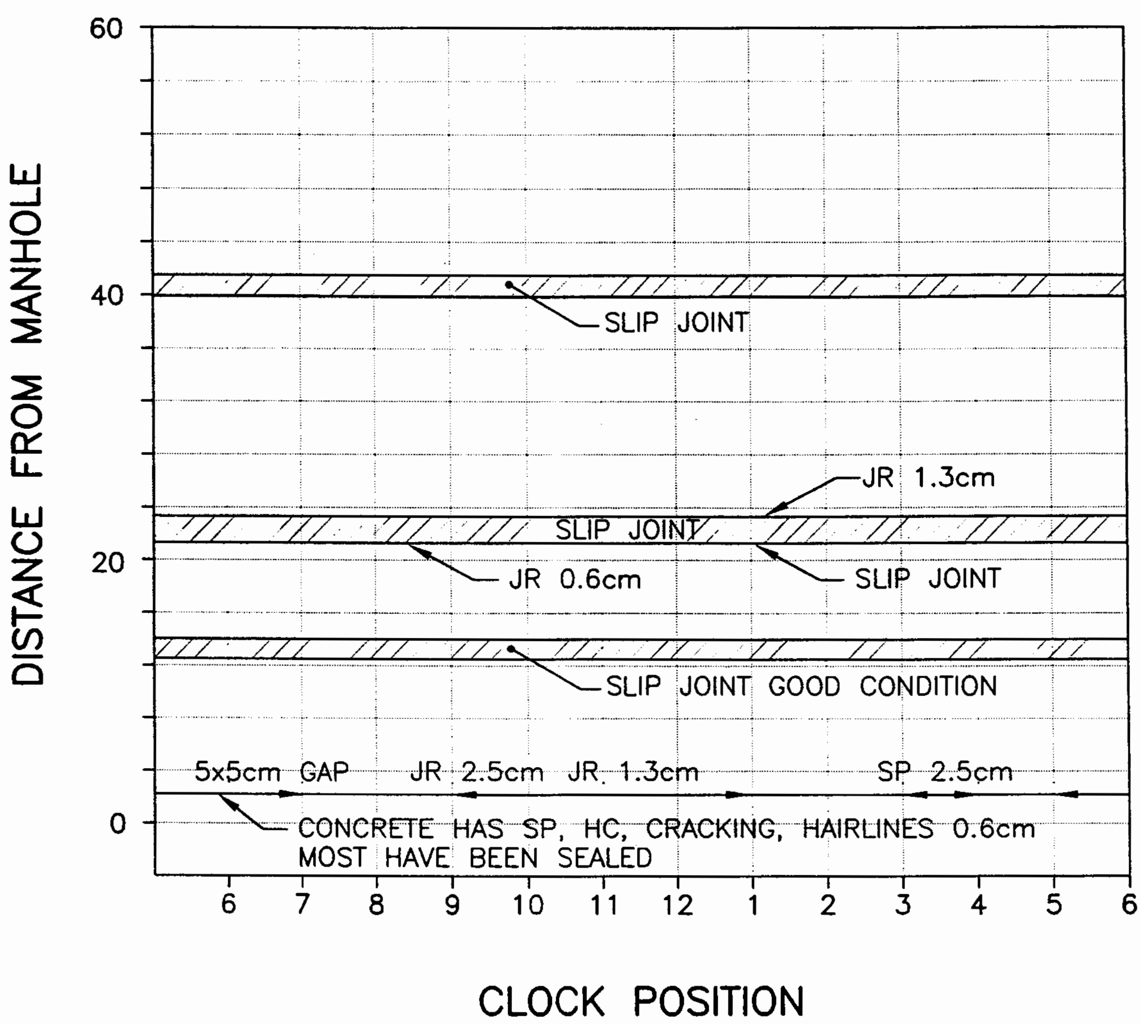
Clock Reference Looking
DOWNSTREAM

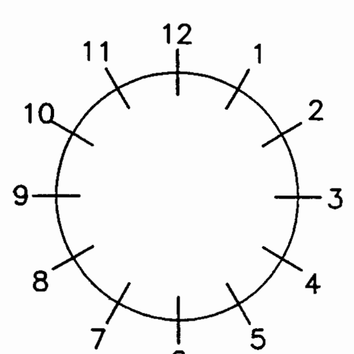
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R43	

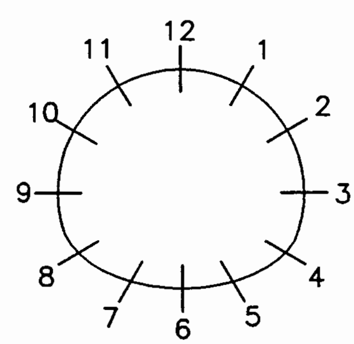
KGS FILE NO.: 97-107-12R43

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



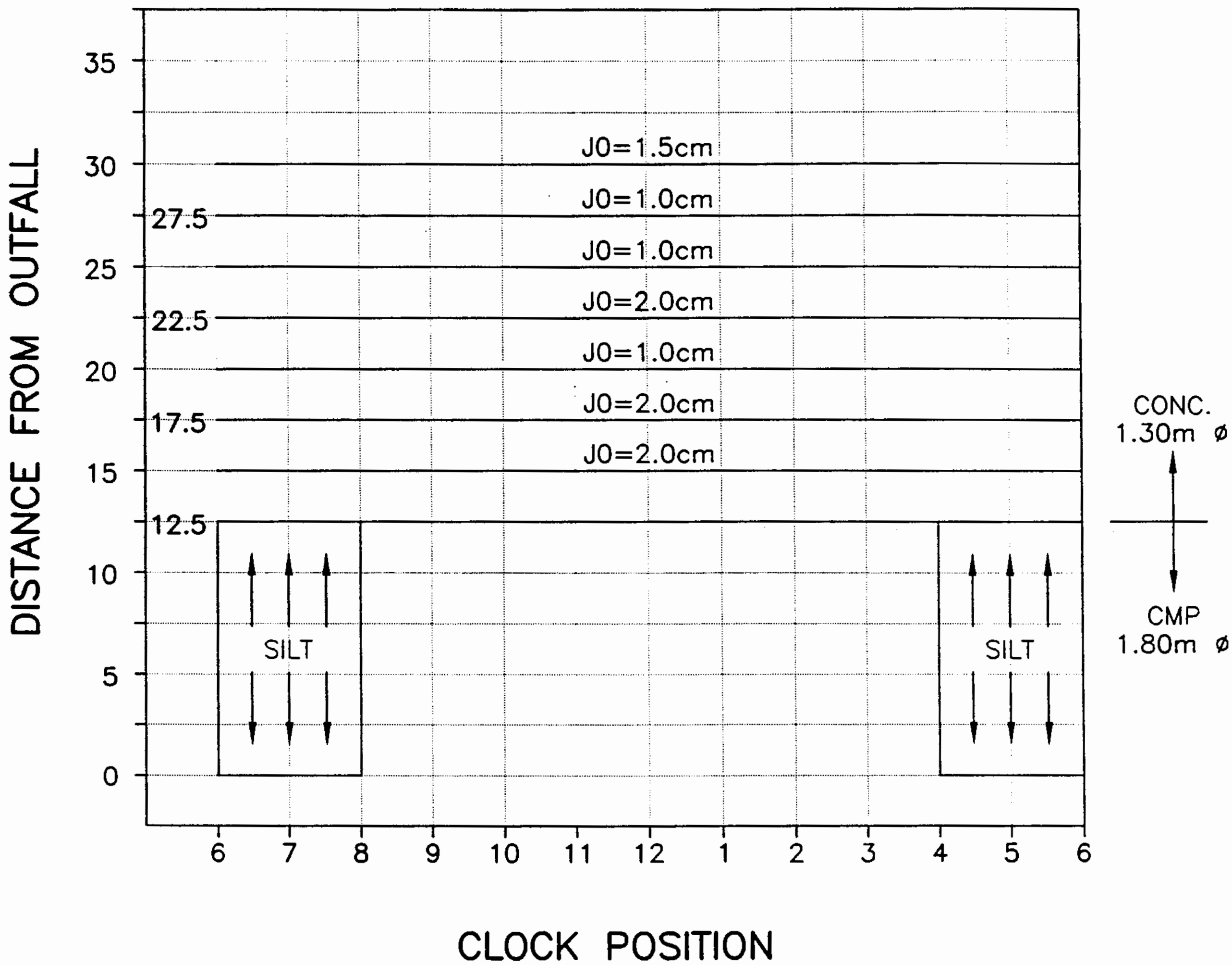
Clock Reference Looking DOWNSTREAM

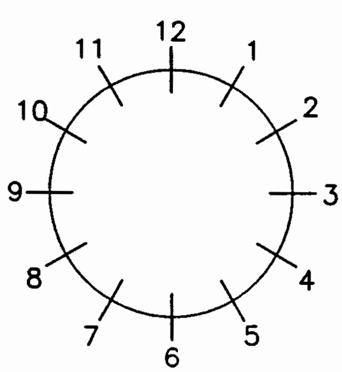
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R44	

KGS FILE NO.: 97-107-12R44

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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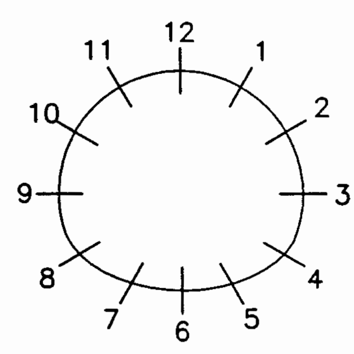


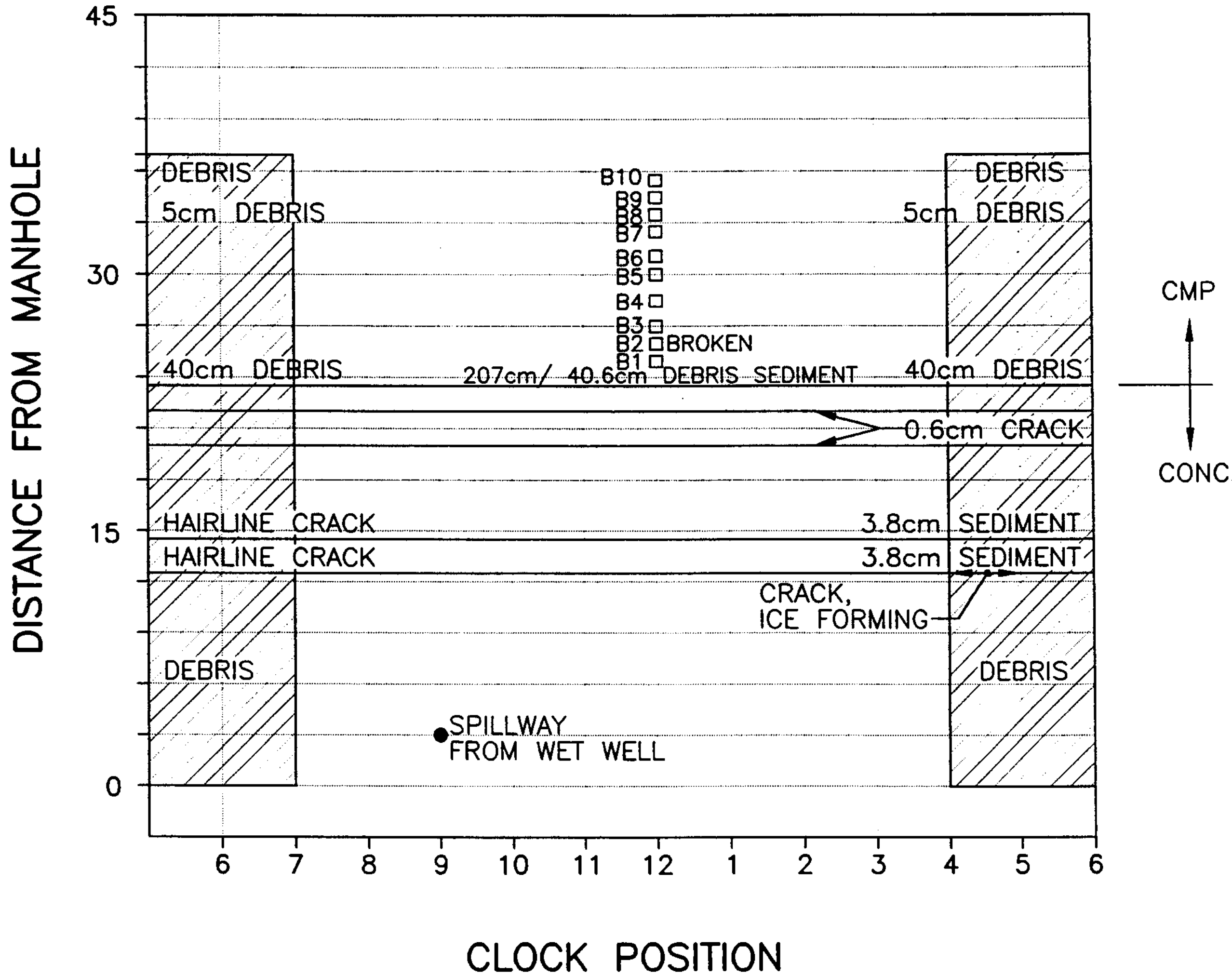
Clock Reference Looking
DOWNSTREAM

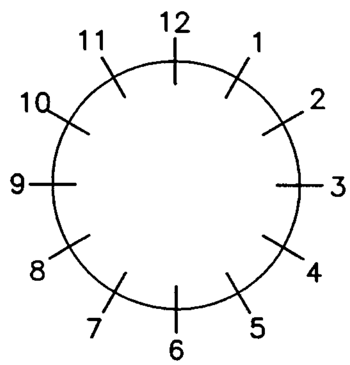
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R45	

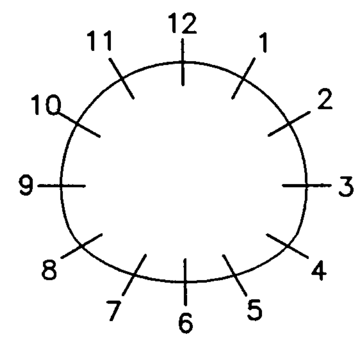
KGS FILE NO.: 97-107-12R45

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



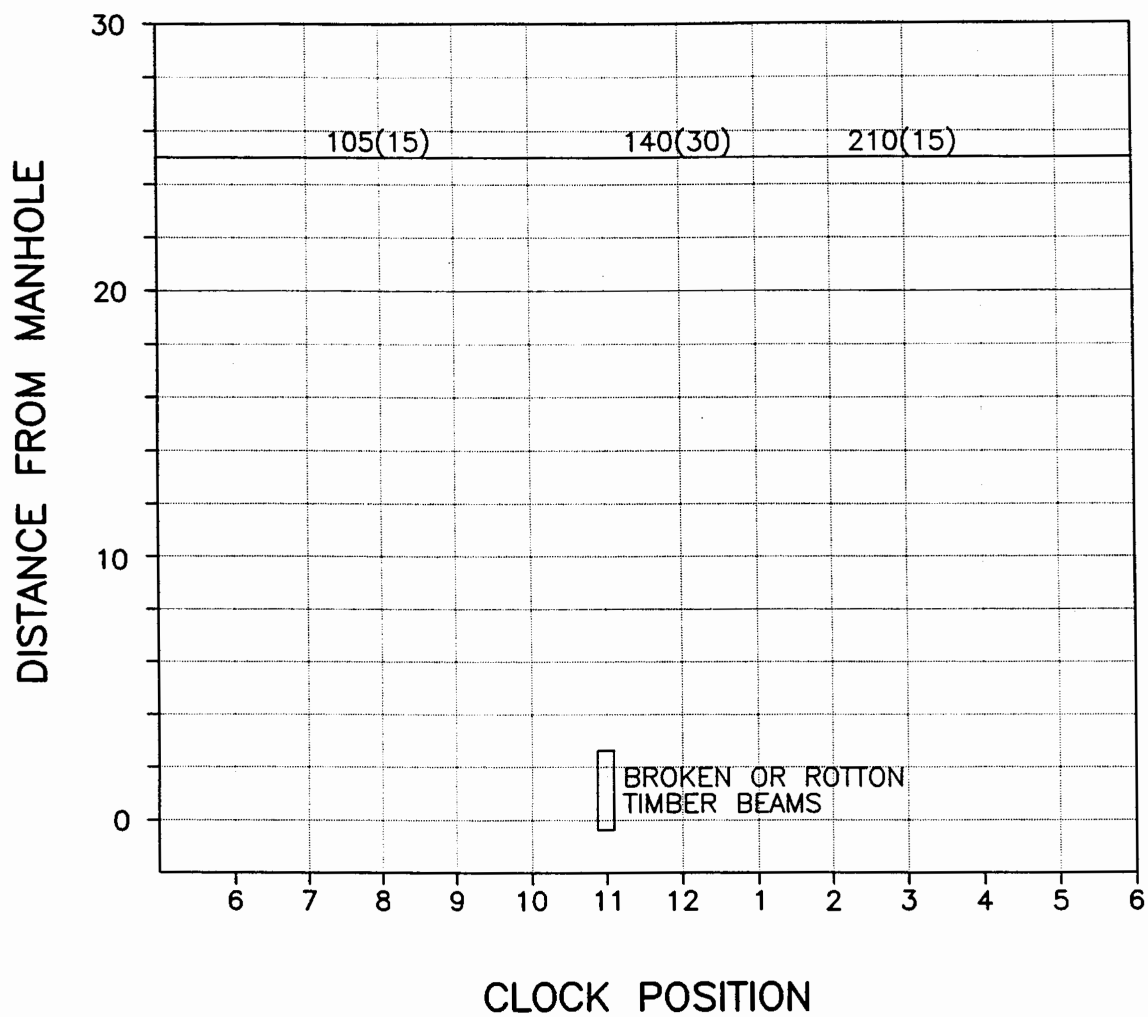
Clock Reference Looking DOWNSTREAM

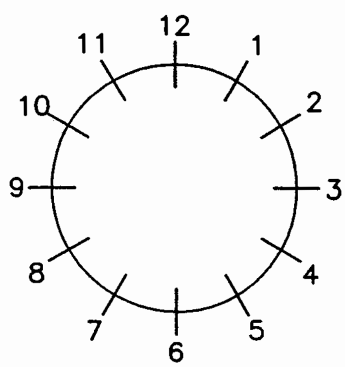
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
B10 □ VERTICAL SUPPORT BEAM	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R46	

KGS FILE NO.: 97-107-12R46

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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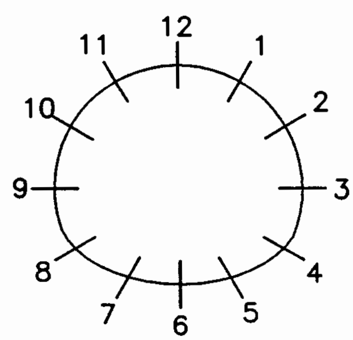


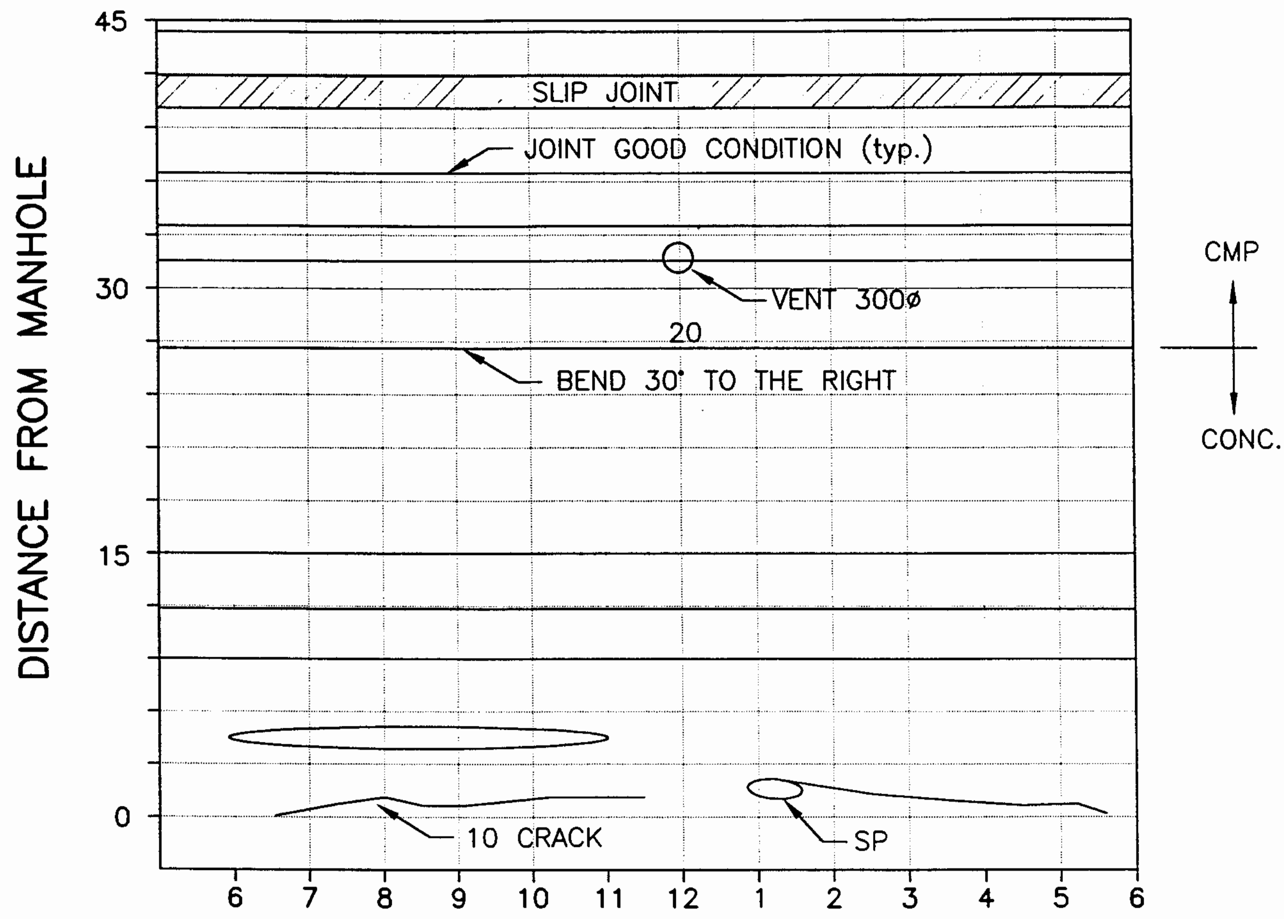
Clock Reference Looking
DOWNSTREAM

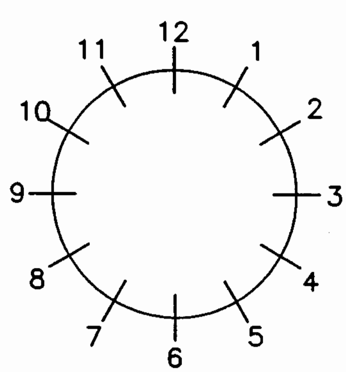
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R48	

KGS FILE NO.: 97-107-12R48

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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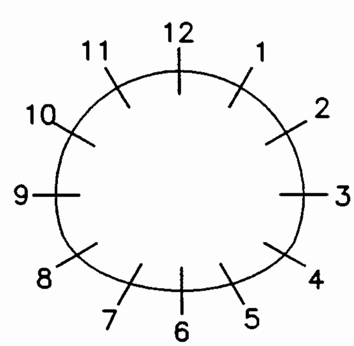


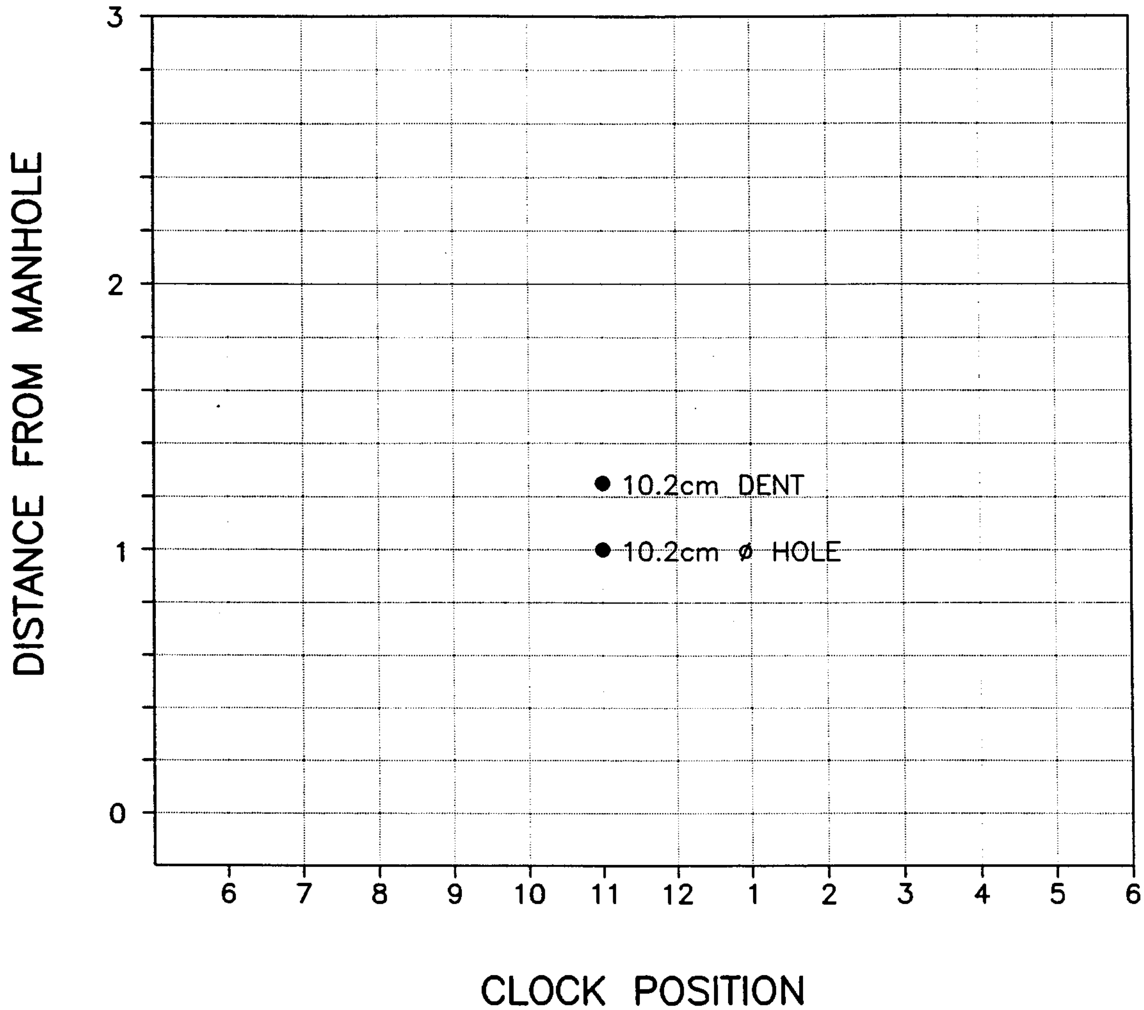
Clock Reference Looking
DOWNSTREAM

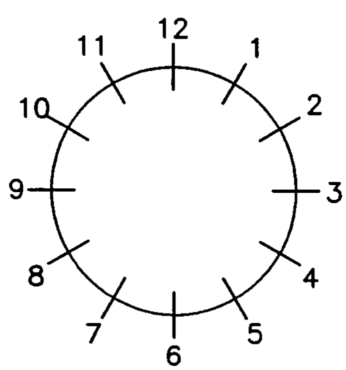
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R49	

KGS FILE NO.: 97-107-12R49

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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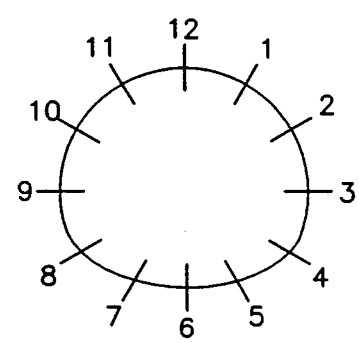


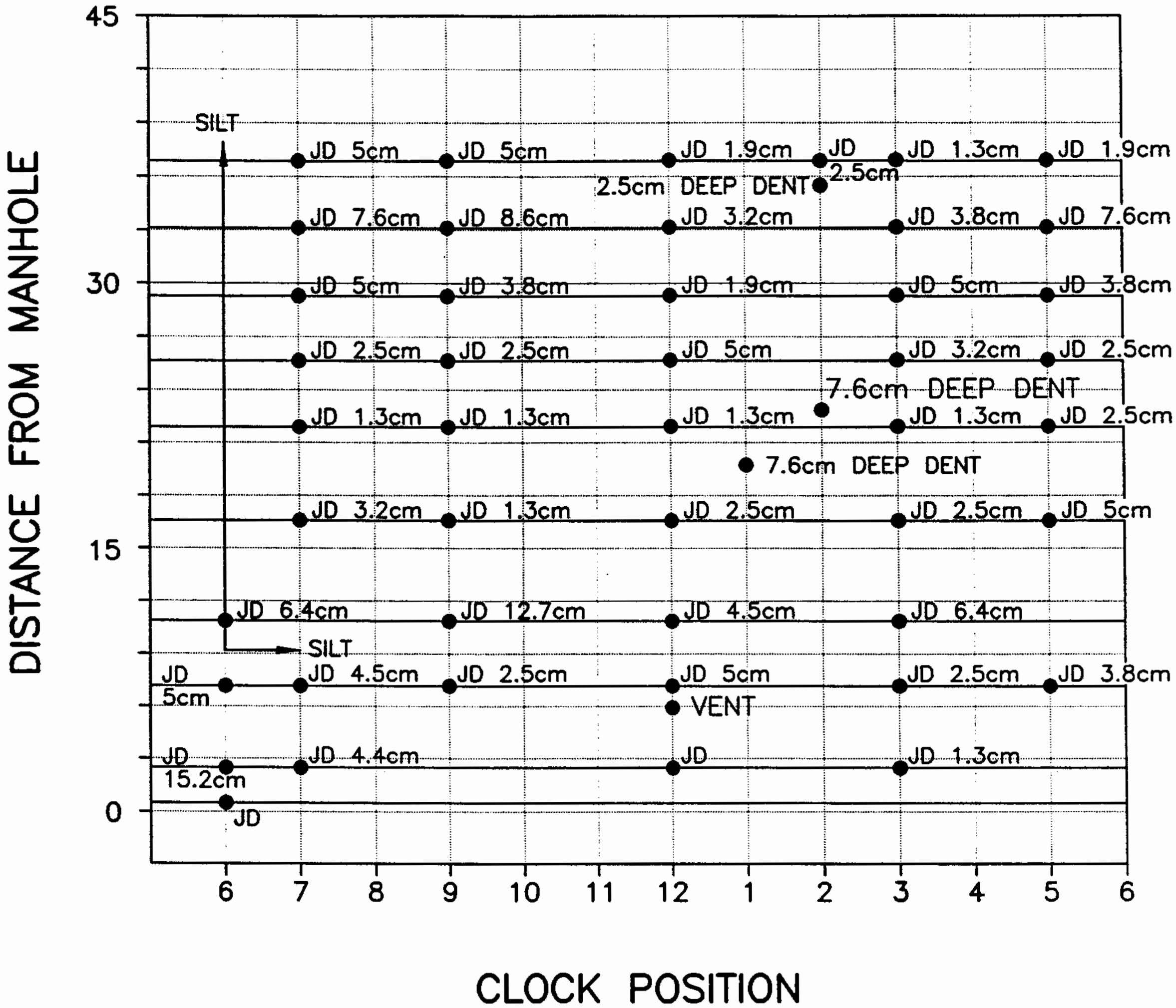
Clock Reference Looking
DOWNSTREAM

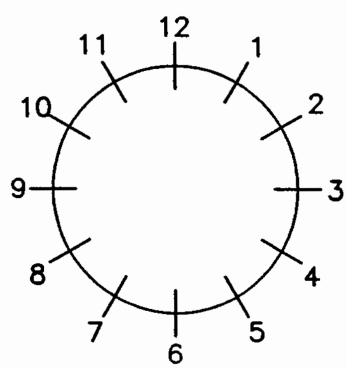
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R51	

KCS FILE NO.: 97-107-12R51

STRUCTURE CONDITION MAPPING CHART





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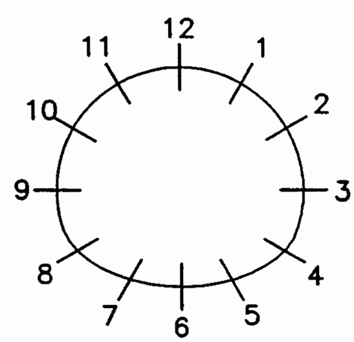


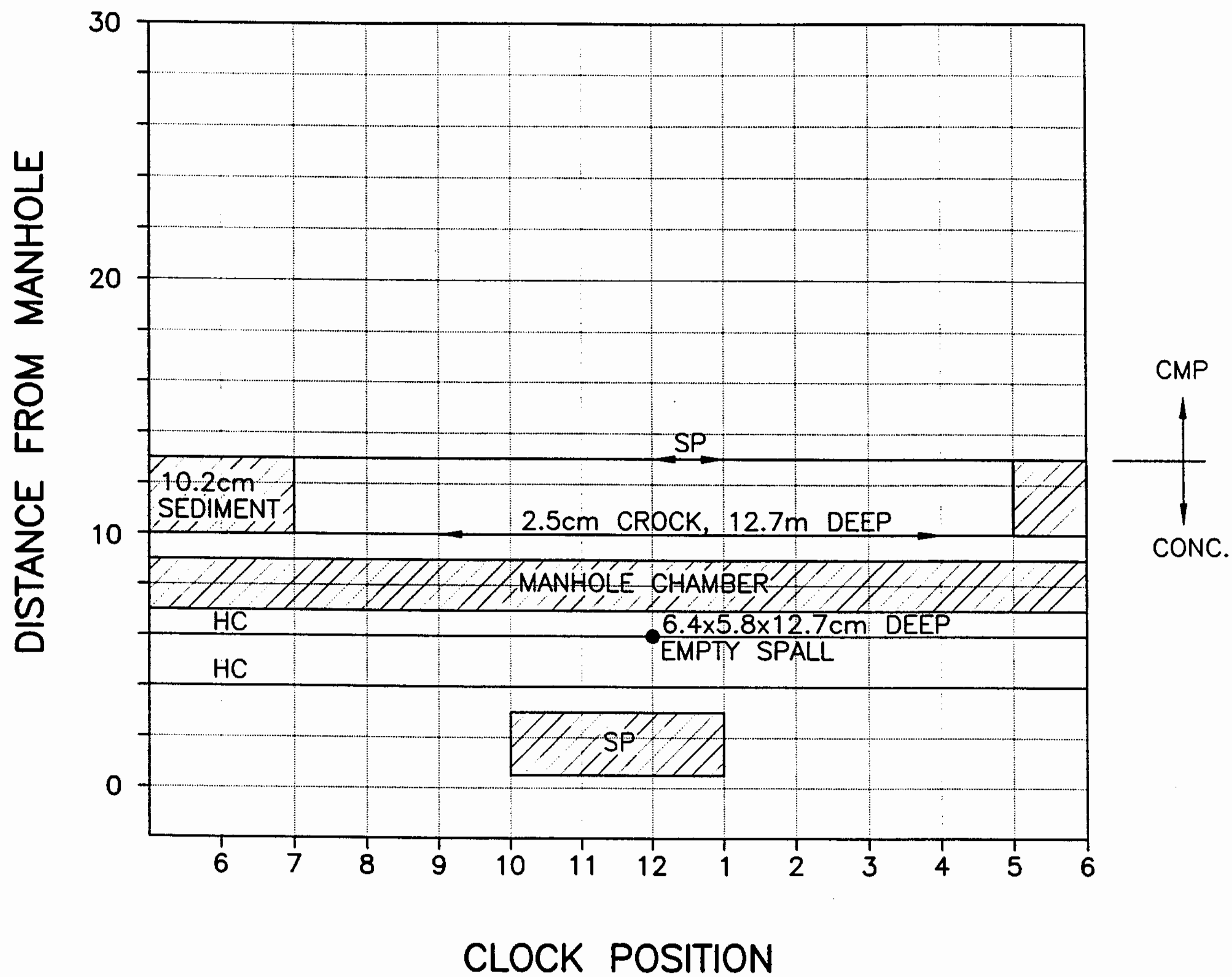
Clock Reference Looking
DOWNSTREAM

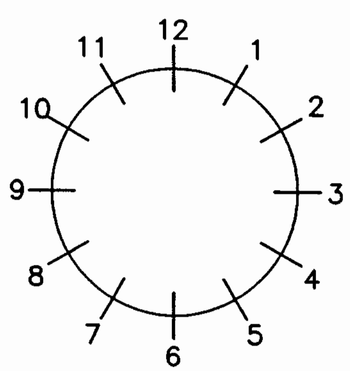
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R52	

KCS FILE NO.: 97-107-12R52

STRUCTURE CONDITION MAPPING CHART





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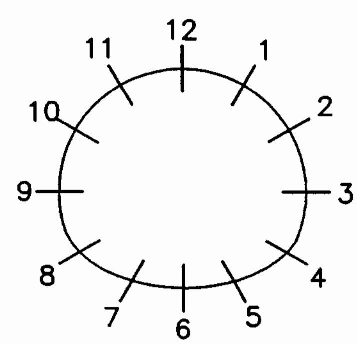
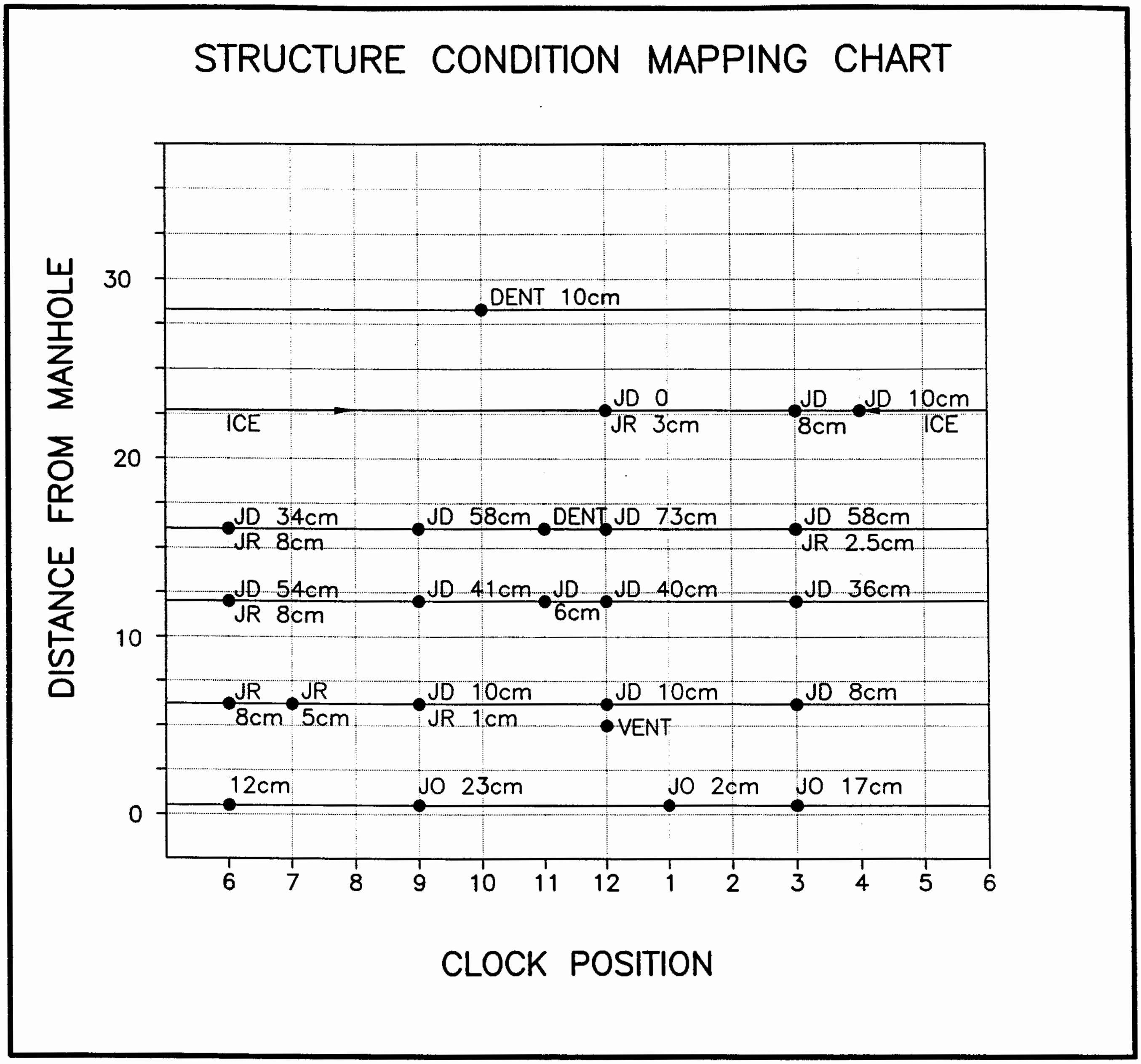


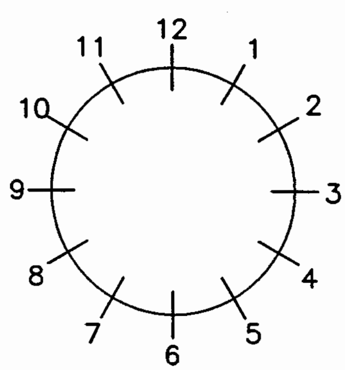
Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R54	

KGS FILE NO.: 97-107-12R54





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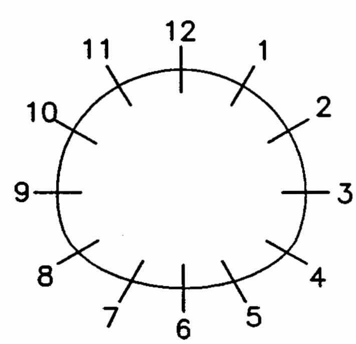


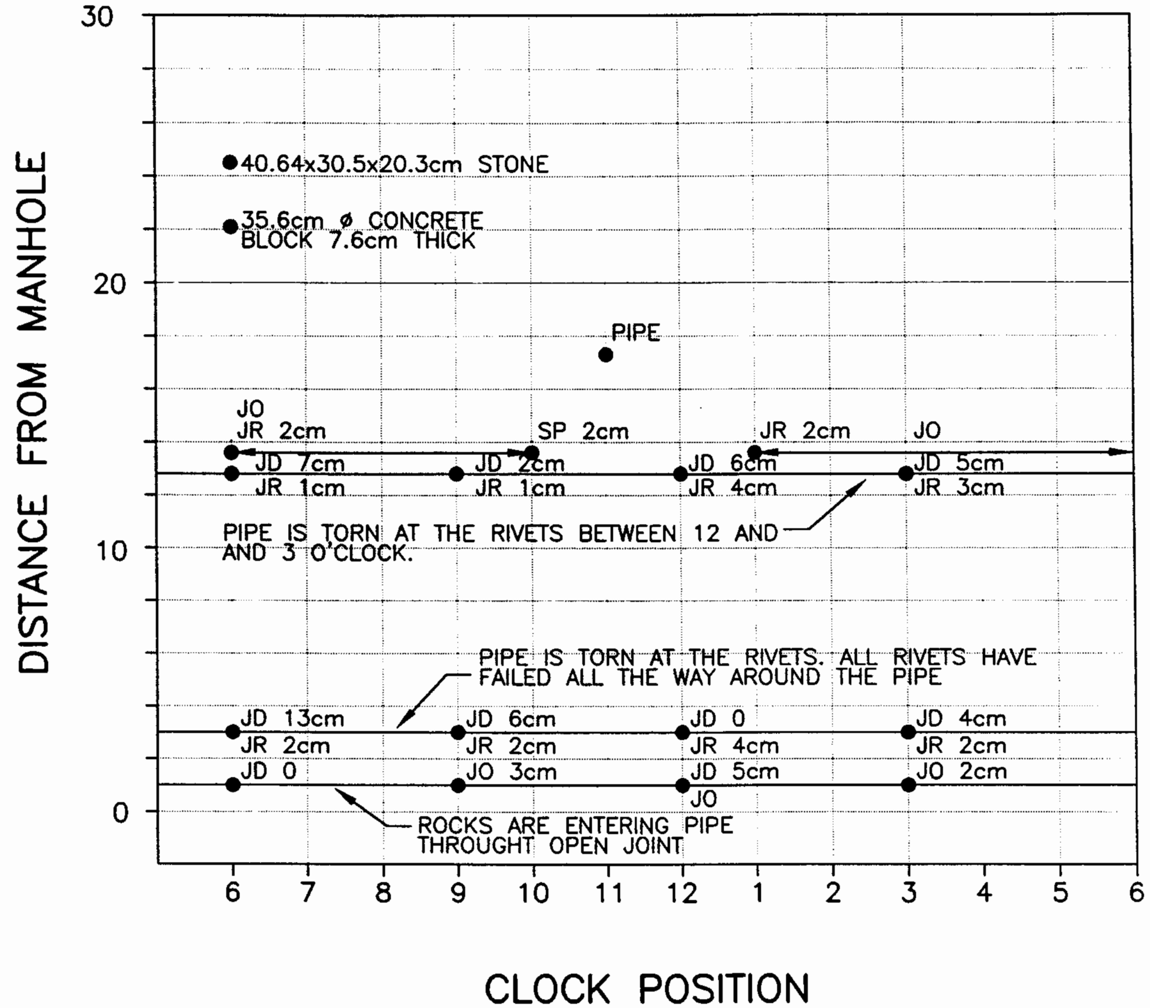
Clock Reference Looking DOWNSTREAM

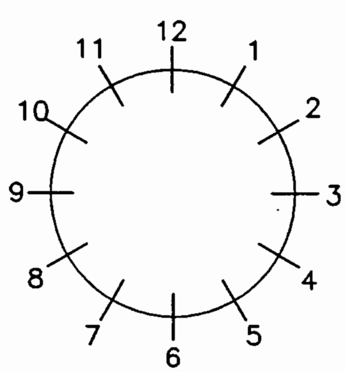
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R55	

KGS FILE NO.: 97-107-12R55

STRUCTURE CONDITION MAPPING CHART





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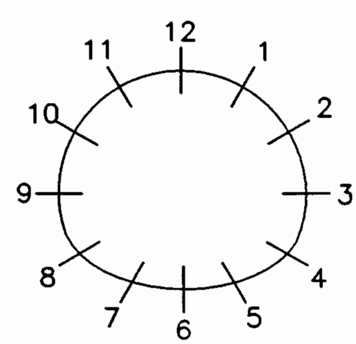


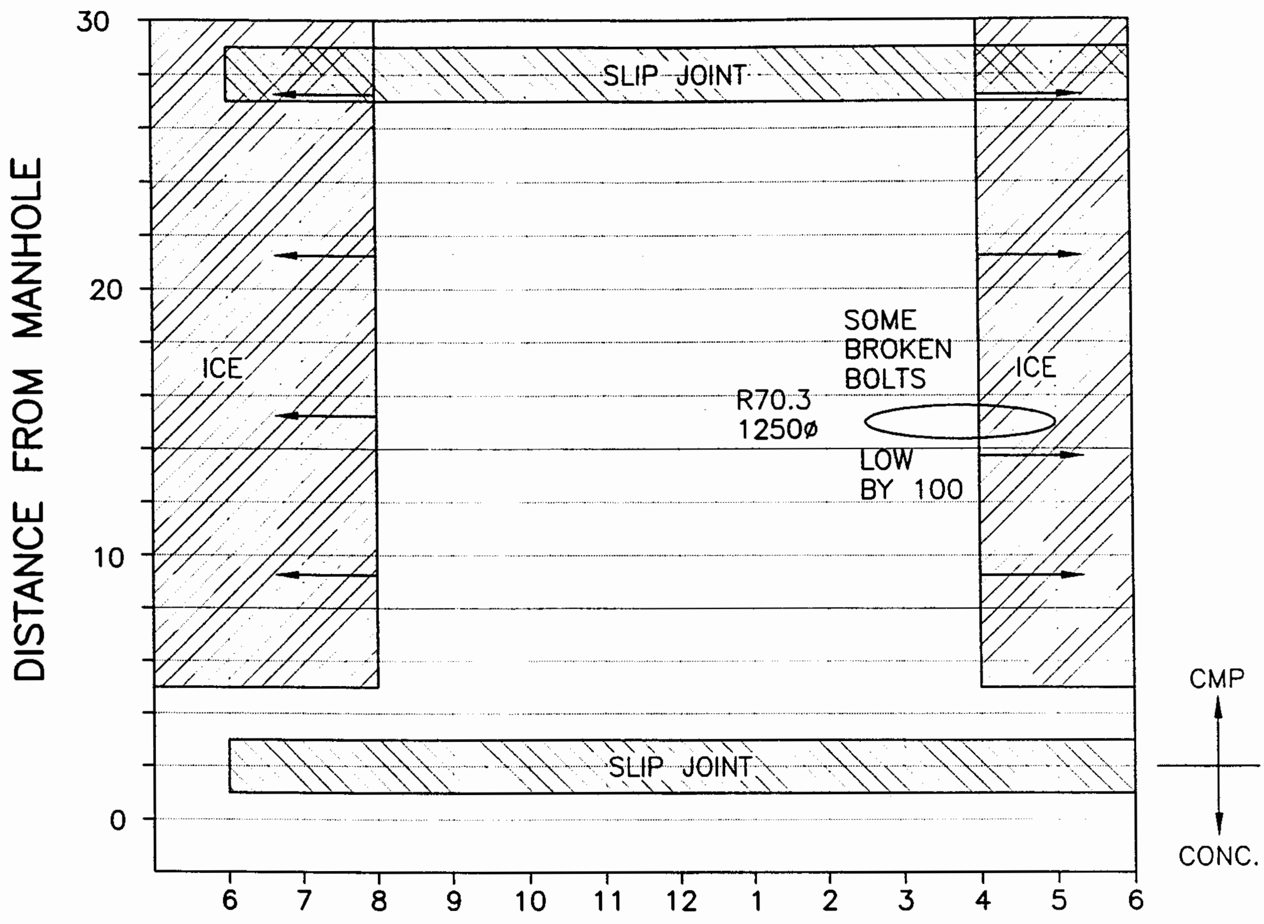
Clock Reference Looking DOWNSTREAM

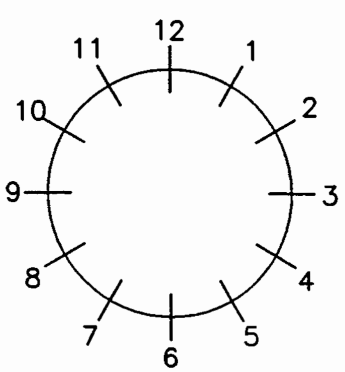
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R58	

KCS FILE NO.: 97-107-12R58

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
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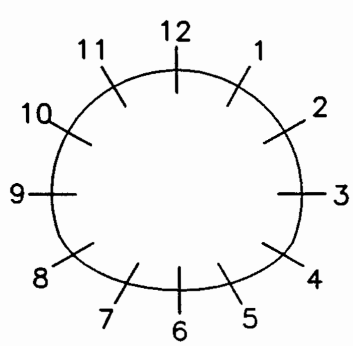


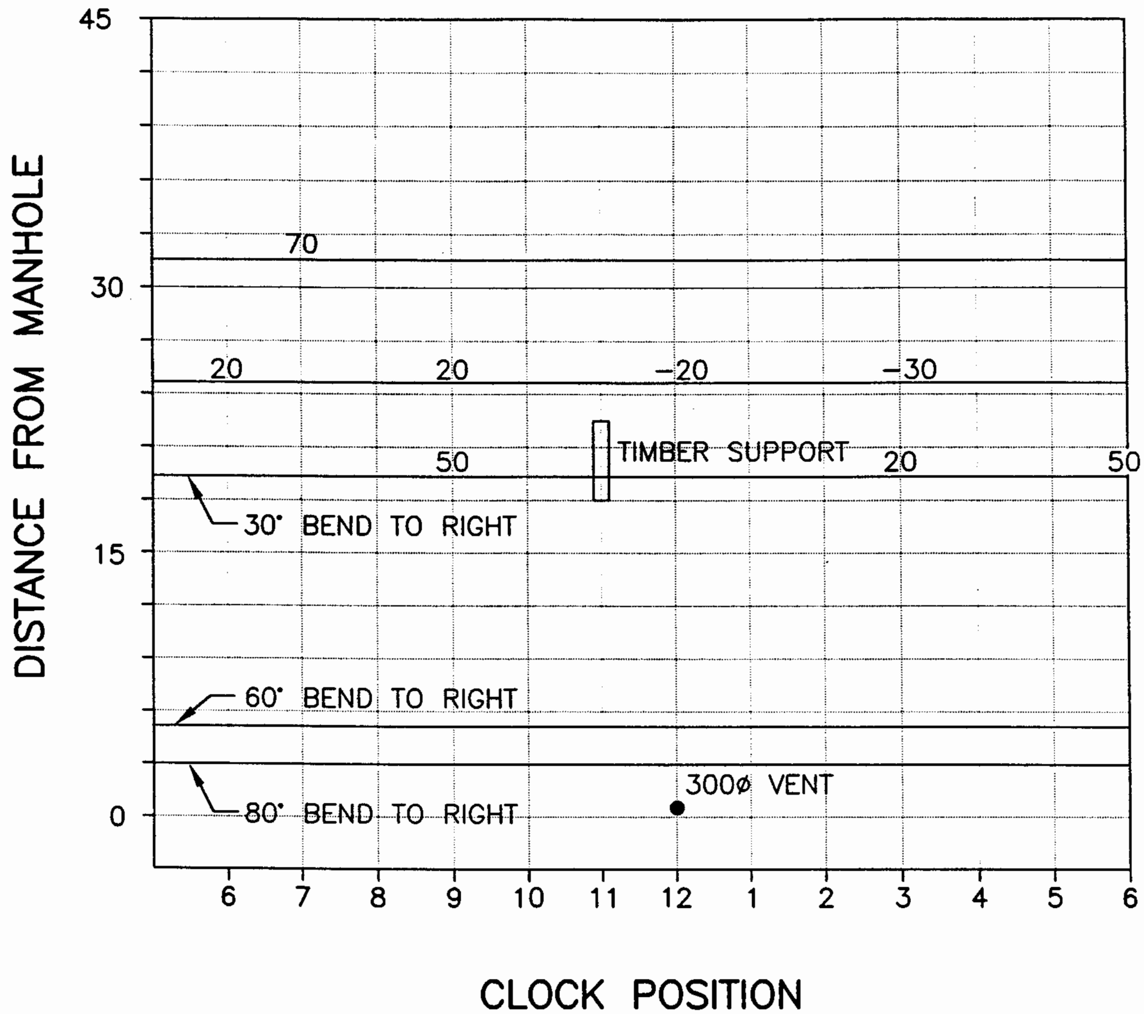
Clock Reference Looking
DOWNSTREAM

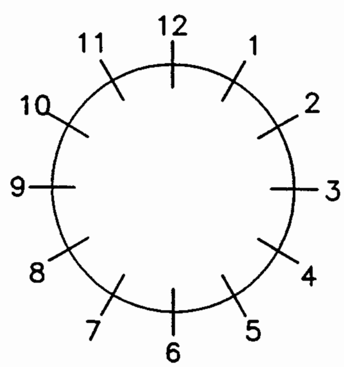
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R70	

KGS FILE NO.: 97-107-12R70

STRUCTURE CONDITION MAPPING CHART





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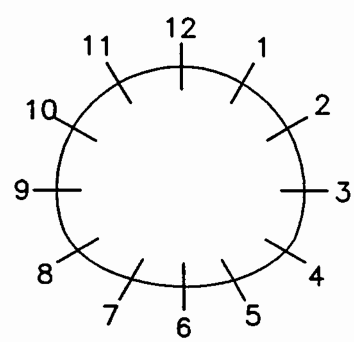


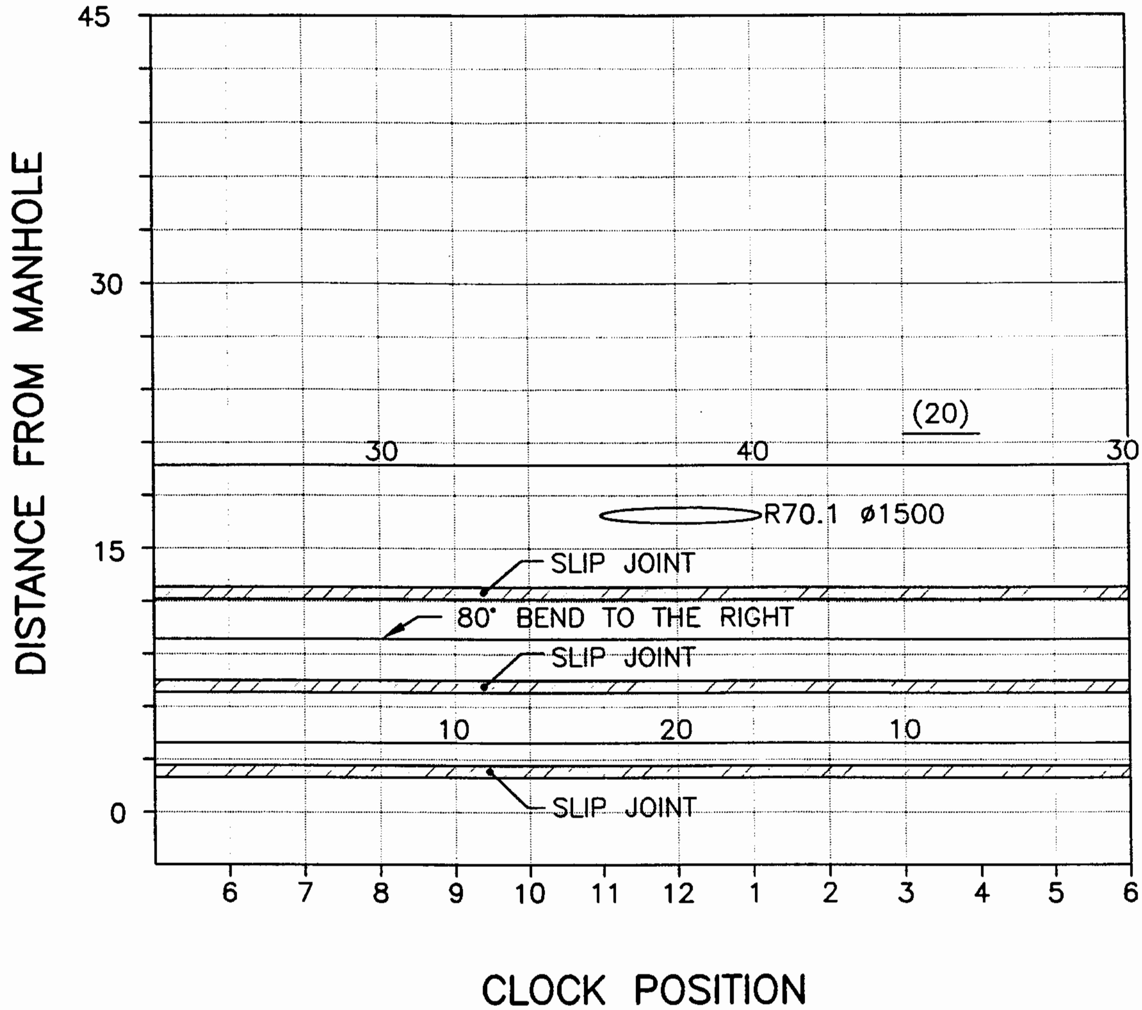
Clock Reference Looking
DOWNSTREAM

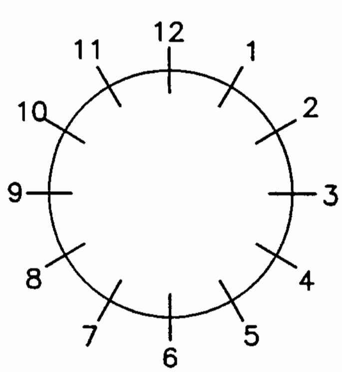
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R70.1	

KGS FILE NO.: 97-107-12R70.1

STRUCTURE CONDITION MAPPING CHART





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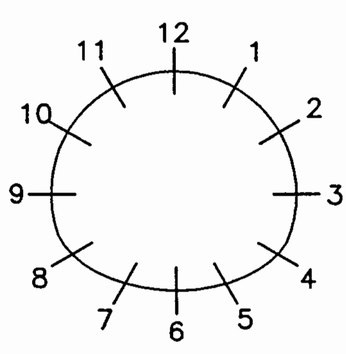


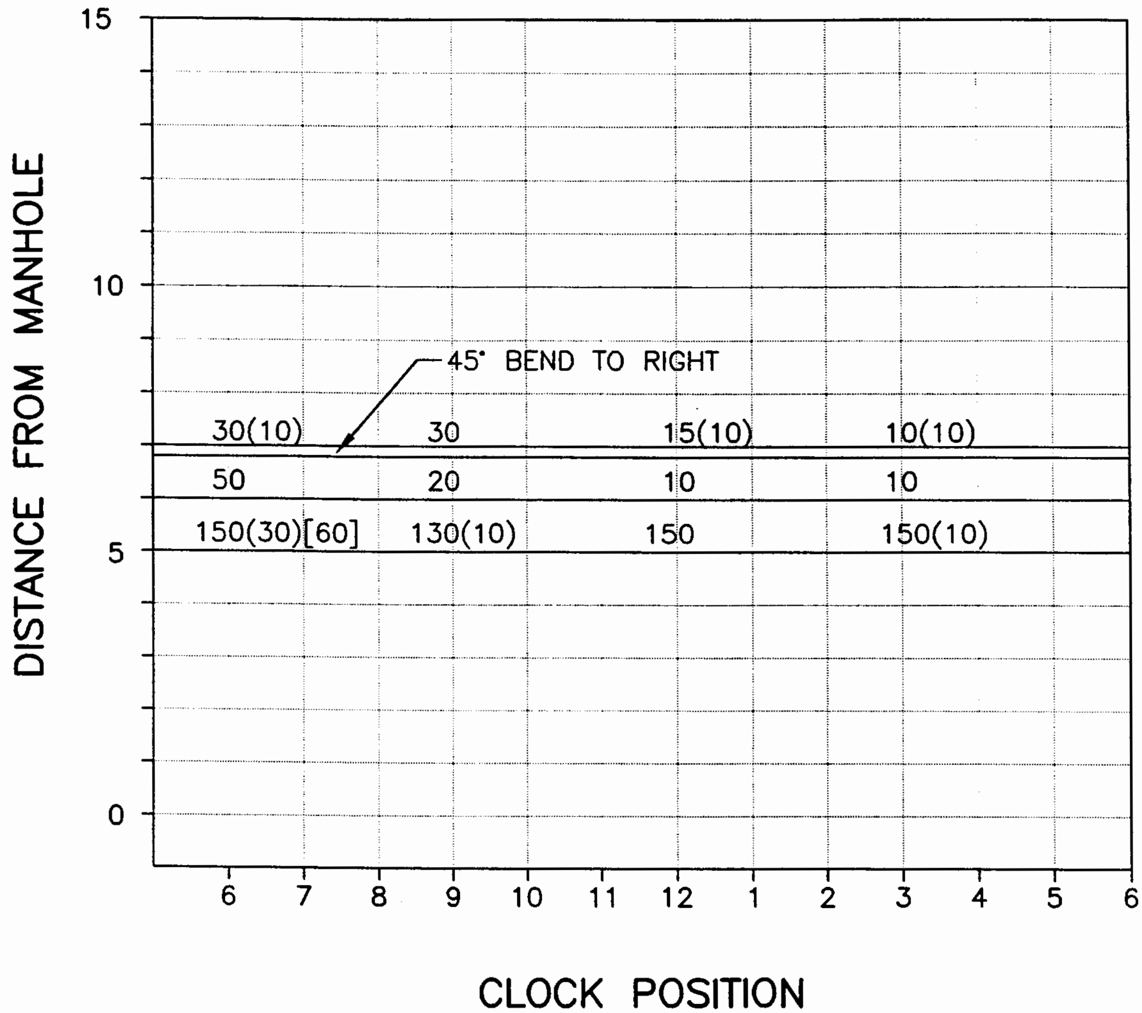
Clock Reference Looking
DOWNSTREAM

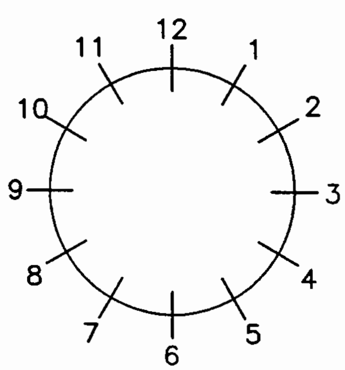
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R70.2	

KGS FILE NO.: 97-107-12R70.2

STRUCTURE CONDITION MAPPING CHART





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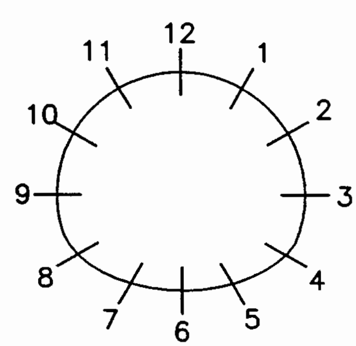


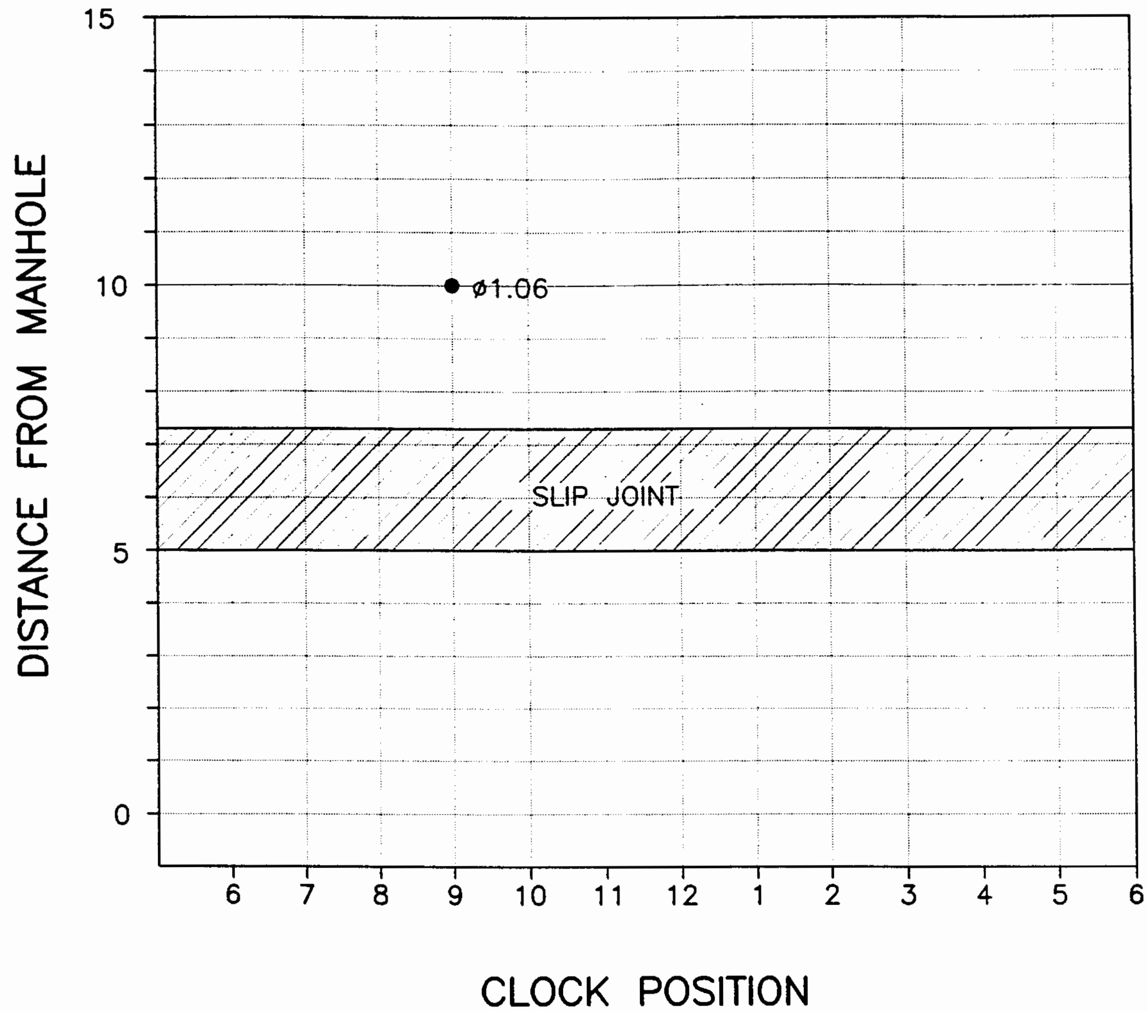
Clock Reference Looking
DOWNSTREAM

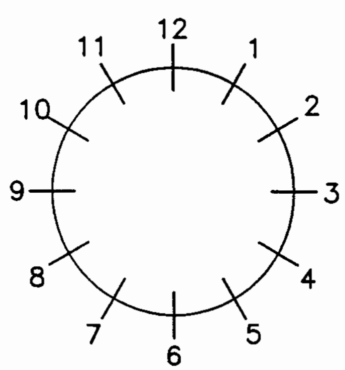
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R71	

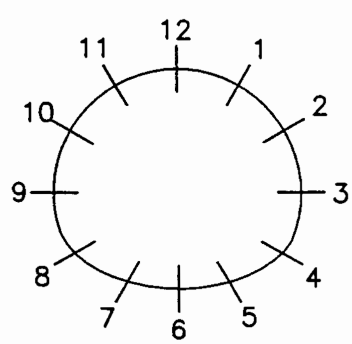
KGS FILE NO.: 97-107-12R71

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking DOWNSTREAM



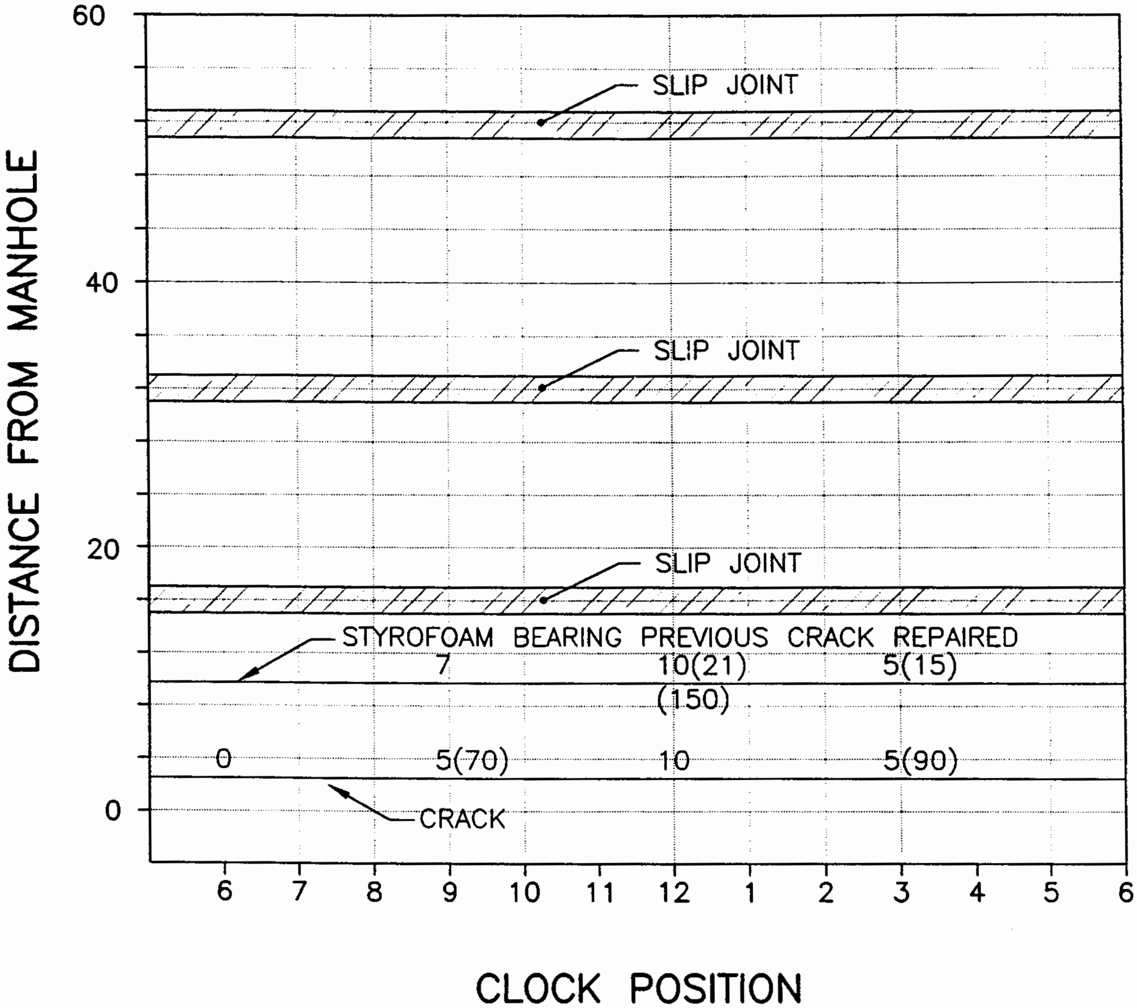
Clock Reference Looking DOWNSTREAM

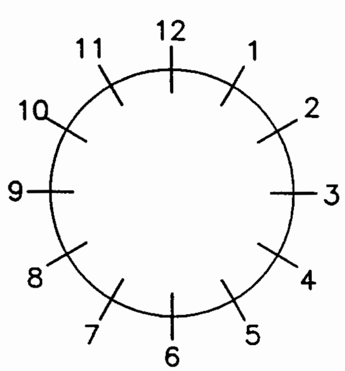
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R72	

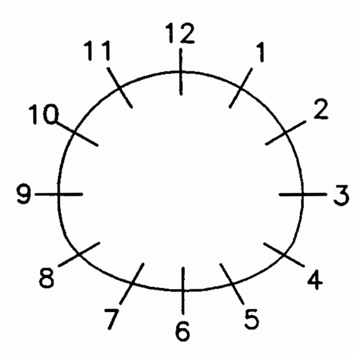
KGS FILE NO.: 97-107-12R72

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



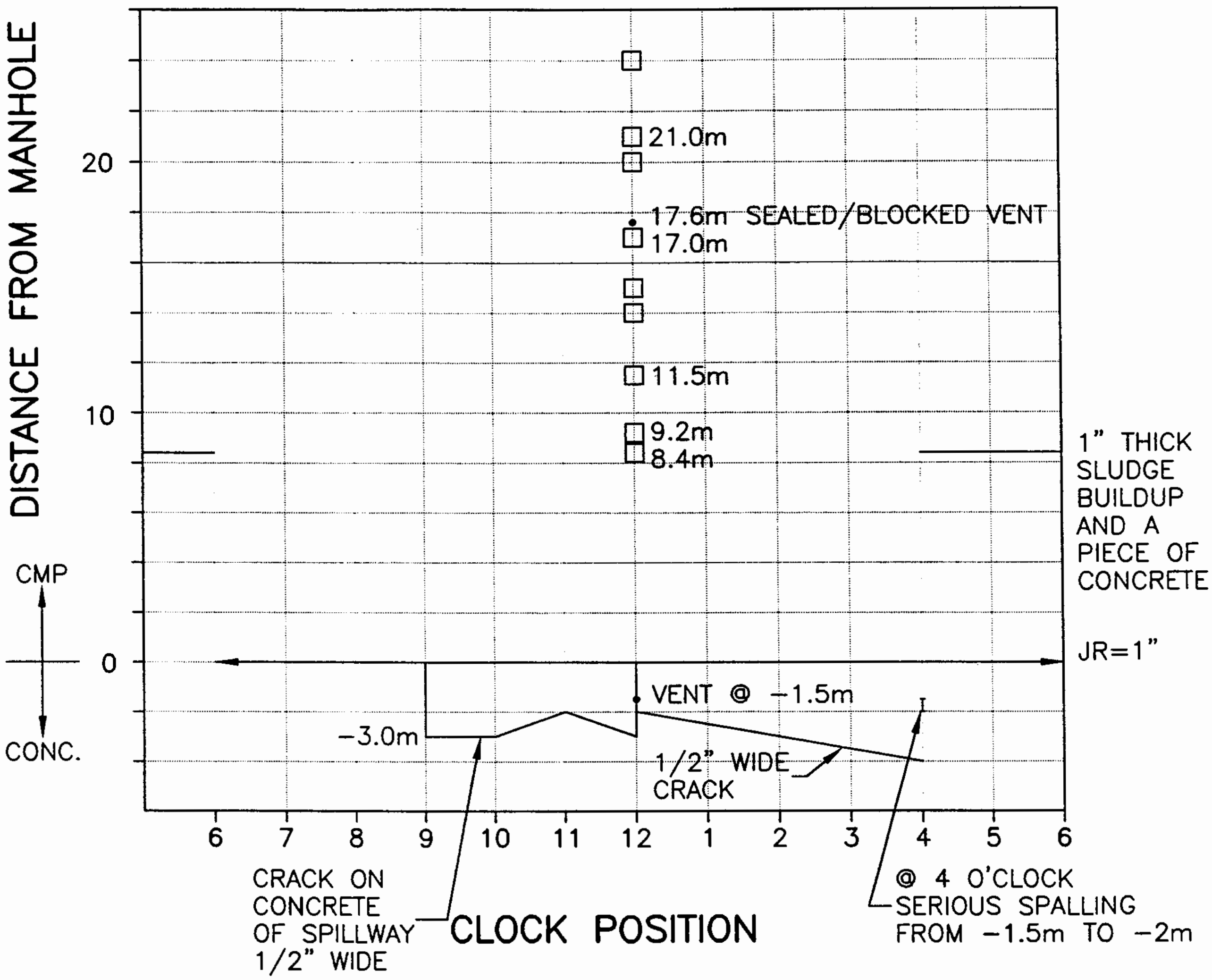
Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R74	

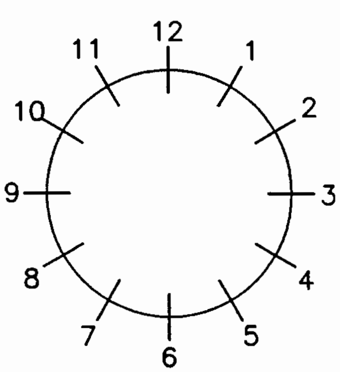
KGS FILE NO.: 97-107-12R74

STRUCTURE CONDITION MAPPING CHART

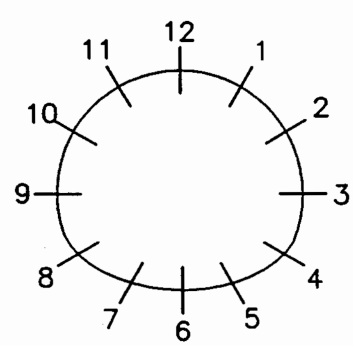


LEGEND

□ 4"x4" WOOD BRACES



Clock Reference Looking DOWNSTREAM



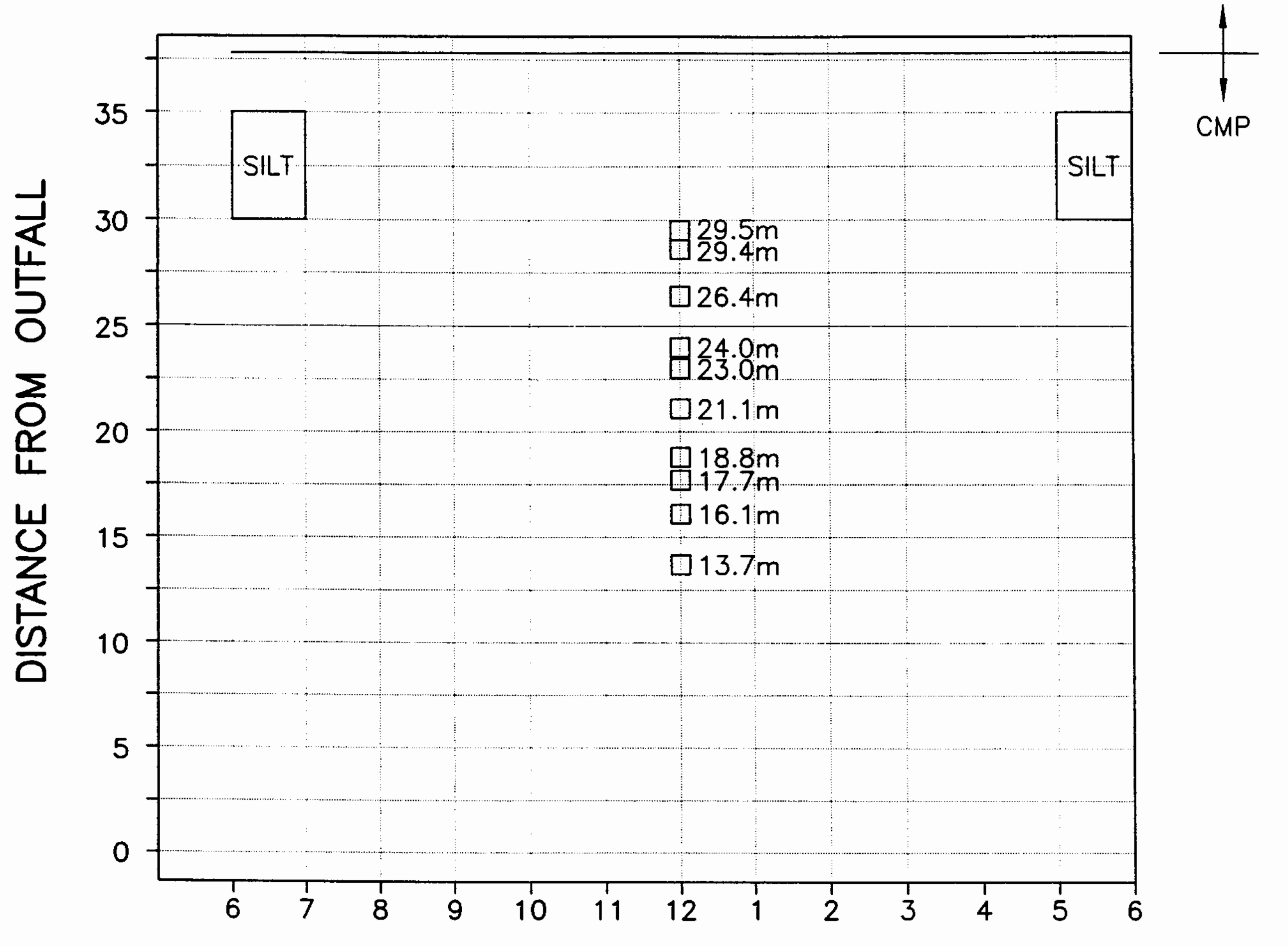
Clock Reference Looking DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R79	

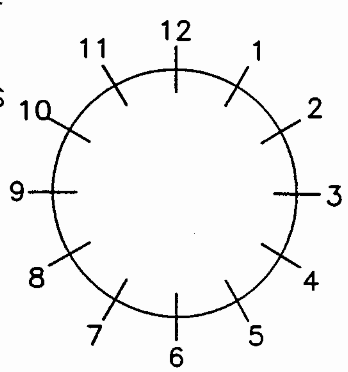
KGS FILE NO.: 97–107–12R79

STRUCTURE CONDITION MAPPING CHART



LEGEND

☐ 4"x4" WOOD BRACES



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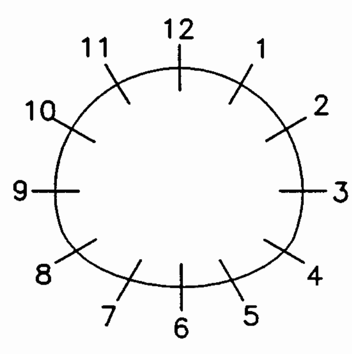


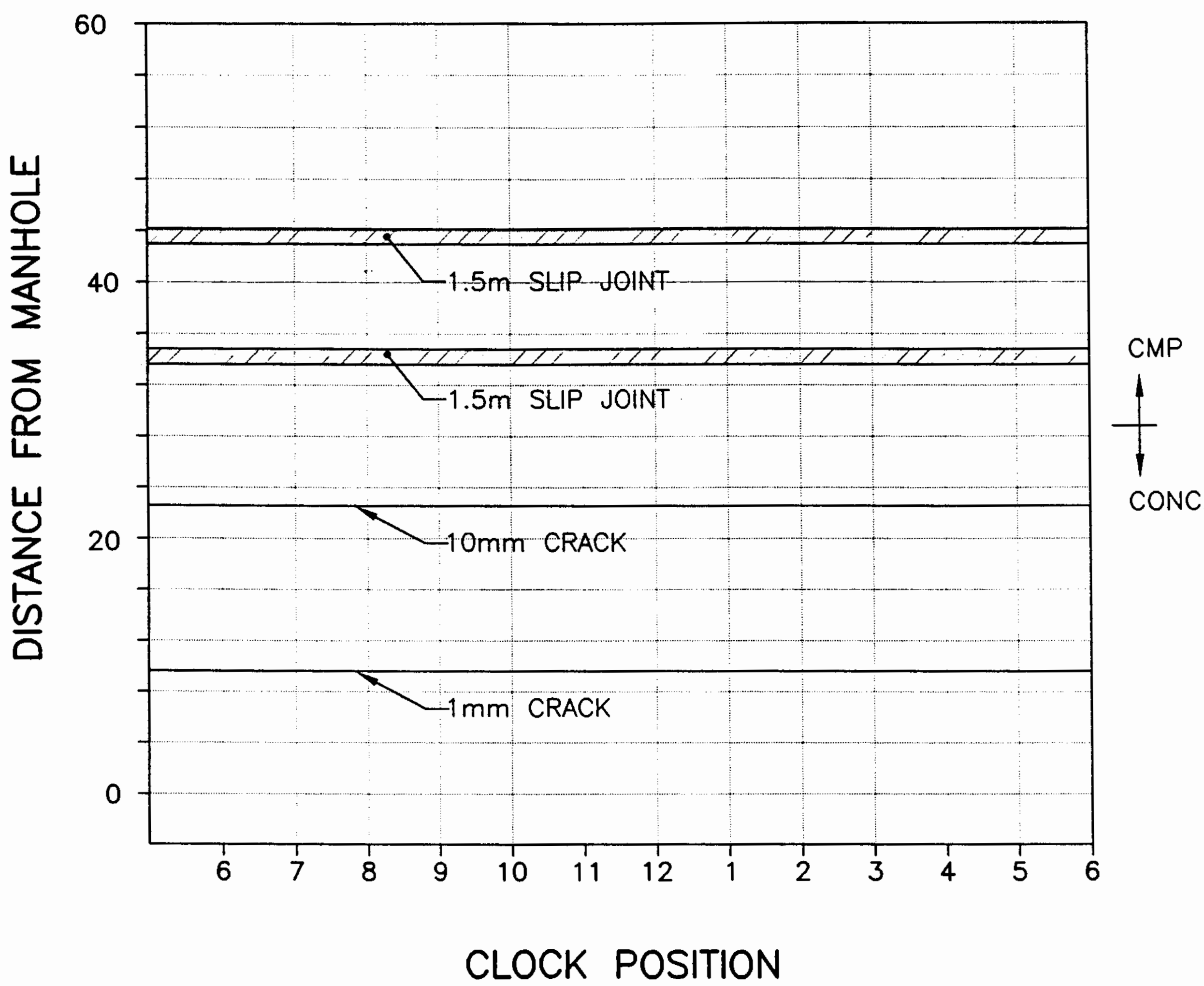
Clock Reference Looking DOWNSTREAM

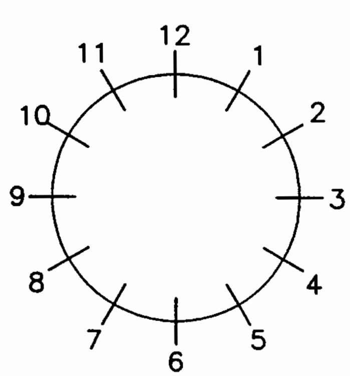
LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R79	

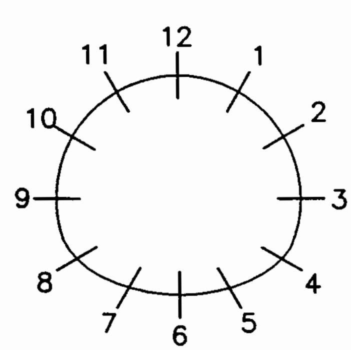
KGS FILE NO.: 97-107-12R79

STRUCTURE CONDITION MAPPING CHART





Clock Reference Looking
DOWNSTREAM



Clock Reference Looking
DOWNSTREAM

LEGEND:

DEFECTIVE CONCRETE:	Spalling	SP	JOINTS:	Raised	JR
	Honeycomb	HC		Displaced	JD
	Erosion/Wear	EW		Spalled	SP
	Delaminated	DC	PIPE IDENTIFICATION:	R80	

KGS FILE NO.: 97-107-12R80

APPENDIX D
Outfalls Inspected
Phase 1 & 2

APPENDIX D

OUTFALLS INSPECTED PHASE 1 AND 2

Outfall ≤ 300 mm - Inspected 1996

Outfall ID	Name	Type	Size
AS-26	Ridgedale S.P.S.	WWS	250
AS-57	Douglas Park Rd.	CS	300
AS-70	Empress Street	LDS	300
AS-71	Empress Street 2	LDS	300
AS-8	St. Charles St. 1	WWS	250
AS-9.9	Sheir Dr.	WWS	250
RR-3	St. Norbert X-Kalay Lift Station Overflow	WWS	300
RR-73	Disraeli Bridge	LDS	300
RR-75	Pritchard Ave.	CS	250

Outfall > 300 mm and < 1200 mm - Inspected 1996

Outfall ID	Name	Type	Size
AS-12	Glasworthy Pl.	LDS	450
AS-14	Coleridge Park Dr. South	LDS	450
AS-15	Paradise Bay	LDS	600
AS-16.5	Orchard Park	LDS	600
AS-21.5	Landoo Dr.	LDS	900
AS-22	Harstone Rd.	LDS	450
AS-23	Dieppe Rd.	WWS	650
AS-25	Shenfield Rd.	LDS	450
AS-27	Ridgedale Cres.	LDS	450
AS-28	Country Club Blvd.	LDS	900
AS-29	Woodhaven Blvd.	CS	450
AS-33	Olive St.	CS	750
AS-37	Strathmillan Rd.	CS	900
AS-38	Vialoux Dr. Cul-de-Sac	LDS	750
AS-62	Parkside Dr.	CS	750
AS-65	St. James Underpass	LDS	900
AS-78	Elm St.	CS	762
AS-83	Arlington St. 1	CS	375
AS-9	St. Charles St. 2	LDS	900
AS-91	Kennedy St.	CS	760
AS-93	Hargrave St.	CS	700
RR-104	Red River Blvd.	LDS	750
RR-108	Eastwood Dr.	LDS	525
RR-2	Lemay Ave.	LDS	900
RR-26	Crane Ave.	CS	600
RR-27	Crane Ave. Outfall	CS	900
RR-28	Dowker Ave. Outfall	LDS	900
RR-30	Lotus Lane	LDS	600
RR-32	Glenview Ave.	LDS	525
RR-34	Oakcrest Pl.	LDS	375
RR-35	Wildwood Golf Coarse	CS	900
RR-37	Calrossie Blvd.	CS	450
RR-40	Kingston Row Underpass	LDS	750
RR-41	Churchill Dr. Underpass	LDS	800
RR-42	Edinburgh St.	CS	800
RR-58	Rue Dumoulin 3	CS	1060
RR-60	Rue La Verendrye FPS	CS	600
RR-68	Archibald Underpass	LDS	750
RR-82	Bredin Dr.	LDS	450
RR-96	Larchdale Cres. SPS	LDS	1050

Outfall ≥ 1200 mm - Inspected 1996

Outfall ID	Name	Type	Size
AS-16.1	Raquette St. 2	LDS	1800
AS-18	McCallum Cres.	LDS	1350
AS-35	Vialoux Dr.	LDS	1500
AS-42	Conway CS	CS	2500
AS-61	Doncaster St.	CS	2250
AS-69	Tylehurst St.	CS	2300
AS-75	Clifton St.	CS	2300
AS-76	Ash St FPS	CS	2100
AS-80	Aubrey St. FPS	CS	2850
AS-86	Cornish Ave FPS	CS	1600
AS-87	Arbuthnot	CS	1400
AS-88	Cornish St. 2	CS	1500
AS-90	Colony St.	CS	1800
AS-94	Donald St.	CS	1900
AS-95	Assiniboine Ave. - FPD	CS	1350
BU-1	Henderson Hwy.	LDS	1375
BU-10	Uxbridge Rd. N.	LDS	1200
BU-2	Henderson Hwy. 2	LDS	1200
RR-10	Radcliffe 1	LDS	1200
RR-100	Whellams Lane	WWS	1200
RR-101	John Black Ave.	LDS	1800
RR-103	Valhalla Dr.	LDS	1675
RR-12	Kings Dr.	LDS	1500
RR-15	Rivergate Dr.	WWS	1350
RR-17	Minnetonka	LDS	2100
RR-19	Banning Rd.	LDS	1370
RR-20	Darcy Dr.	CS	2200
RR-22	Plaza Dr.	LDS	2400
RR-23	Riviera Cres. Outfall	LDS	2000
RR-24	Falconer Bay	LDS	1200
RR-31	Dunkirk Dr.	LDS	1400
RR-33	Dunham Rd.	LDS	900
RR-36	Somerset Ave.	CS	1800
RR-38	Cockburn St. FPS	CS	1500
RR-39	Cockburn St. Lift Station Outfall	CS	1800
RR-43	Killarney St.	LDS	1200
RR-44	Mager St. FPS	LDS	1800
RR-46	Metcalfe Pl.	CS	2000
RR-48	Glasgow Ave.	LDS	1200
RR-49	Jessie Ave	CS	1900
RR-51	Marion St. FPD	CS	1600
RR-52	Marion St. 2	CS	1800
RR-54	Rue Despins	CS	1400
RR-55	Rue Despins FPD	CS	1200
RR-57	Rue Dumoulin 2	CS	1200
RR-7	Perimeter Hwy. at Cloutier Dr.	CS	1800

Outfall $\geq$ 1200 mm - Inspected 1996

Outfall ID	Name	Type	Size
RR-70	Watt St.	CS	3700
RR-70.1	Watt St. 2 (connector pipe)	CS	1500
RR-70.2	Watt St. 3 (connector pipe)	CS	1850
RR-70.3	Watt St. 4 (connector pipe)	CS	1250
RR-71	Syndicate St. - Flood Pump Discharge	CS	1800
RR-74	Selkirk Ave.	CS	1800
RR-76	Burrows Ave.	CS	2400
RR-79	Hart Ave.	CS	2850
RR-80	St. John's Park MH	CS	3000
RR-83	Polson Ave. FPS	CS	1800
RR-84	Munroe Ave. FPS	CS	2500
RR-88	Jefferson Ave.	CS	3300
RR-9	Rice Dr.	LDS	1500
RR-90	Linden Ave.	CS	1800
RR-91	Linden Ave. - Flood Pump Discharge	CS	1675
RR-94	Newton Ave.	CS	1850
RR-95	Armstrong Ave.	CS	2700
RR-98	Hawthorne Ave.	CS	2200
SE-1	Mission FPS	CS	2600
ST-18	Hamilton Ave.	LDS	1500
ST-21	Crestview Park Dr. (retention pond drainage)	LDS	1676
ST-3	Booth Dr.	LDS	1850

Private Outfall - Inspected 1996

Outfall ID	Name	Type	Size
AS-2	P.T.H. 100 W. Side	LDS	1400
AS-3	P.T.H. 100 W. Side	LDS	1200
AS-4	P.T.H. 100 E. Side	LDS	800
AS-5	P.T.H. 100 E. Side	LDS	1200
AS-5.1	P.T.H. 100 E. Side	LDS	1500
RR-97	Kildonan Park #1	LDS	250
RR-105	Henderson Hwy. (Private)	LDS	600

Outfall > 300 mm and < 1200 mm - Inspected 1997

Outfall ID	Name	Type	Size
AS-10	Pender St.	LDS	900
AS-11	Barker Bvld.	LDS	1075
AS-23.1	Dieppe Rd. 2	WWS	900
AS-60	Chataway Blvd.	CS	900
AS-60B	Chataway Blvd. 2	LDS	600
AS-61A	Edgeland Blvd.	LDS	400
AS-66	King Edward St.	LDS	650
AS-66.8	Wellington Cres. 2	LDS	450
AS-67A	Route 90 Bridge	LDS	450
AS-68	Wellington Cresc.	LDS	500
BU-11	Uxbridge Rd. S.	LDS	900
BU-12	McIvor Ave.	LDS	400
BU-13	Raleigh St. 1	LDS	400
BU-14	Raleigh St. 2	LDS	750
BU-15	Raleigh St. 3	LDS	750
BU-3	Bonner Ave.	LDS	525
BU-6	Delbrook Cres.	LDS	400
LS-2	Rue Des Trappistes	LDS	450
LS-4	La Maire Ave.	LDS	1000
OM-1	Raglan Rd.	LDS	400
OM-3	Empress St. 1	LDS	750
OM-4	Velodrome 1	LDS	380
RR-18	River Pointe Pl.	LDS	1050
RR-21	Bishop Grandin Blvd. 2	LDS	750
RR-25	Moore Ave.	LDS	1100
RR-34.8	Riverdale Ave.	LDS	600
RR-6	Grandmont Blvd.	WWS	750
RR-8	Stormont Dr.	LDS	400
SE-12	Kavanagh St.	LDS	750
SE-2	Rue Laverendrye	LDS	600
SE-21	St. Catherine St. 1	LDS	600
SE-27	Evans Ave.	LDS	1067
SE-28	Cote St.	WWS	450
SE-29	Gareau St.	LDS	800
SE-30	Guay Ave.	LDS	750
SE-30.1	Egerton Rd.	LDS	900
SE-31	Blenheim Ave.	LDS	1060
SE-32	Imperial Ave.	LDS	750
SE-33	Humbolt Ave.	LDS	900
SE-36	Comanche Rd.	WWS	600
SE-37	Fermor Ave.	LDS	600
SE-38	Niakwa Rd. 1	LDS	450
SE-38.1	Niakwa Rd. 2	LDS	450
SE-43	Southbridge Dr.	LDS	900
SE-47	Marlene St.	LDS	530
SE-5	Rue Dumoulin	WWS	600

Outfall > 300 mm and < 1200 mm - Inspected 1997

Outfall ID	Name	Type	Size
ST-11	Kirby Dr.	LDS	600
ST-12	Amarynth Cres. 2	LDS	400
ST-15	Valleyview Dr. 1	WWS	600
ST-16	Valleyview Dr. 2	LDS	1050
ST-17	Harvest Lane	LDS	400
ST-19	Silver Ave.	WWS	525
ST-20	Voyageur	WWS	600
ST-22	Crestview Park Dr.	LDS	762
ST-23	Acheson Dr.	LDS	900
ST-24	Saskatchewan Ave.	LDS	361
ST-6	Setter St.	LDS	600
ST-7	Greenway Cres.	LDS	600
ST-8	Lonsdale Dr.	LDS	600
ST-9	Amarynth Cres.	LDS	525

Outfall $\geq$ 1200 mm - Inspected 1997

Outfall ID	Name	Type	Size
AS-13	Willow Ridge Rd.	LDS	1800
AS-19	Carroll Rd.	LDS	1800
AS-58	Park Bvld.	LDS	2400
AS-63	Riverbend Cres.	CS	2340
AS-74	Clifton St. FPD	CS	2100
AS-81	Ruby St. 1	CS	2100
BU-9	Pennefather St.	LDS	1350
FL-1	Deacon Reservoir	LDS	1500
FL-2	Kildare at Floodway	LDS	3000
RR-33	Dunham Rd. Outfall	LDS	1200
RR-45	Baltimore St. FPS	CS	1800
RR-50.5	Park Dr.	LDS	1200
RR-59	Rue La Verendrye	CS	1200
RR-63	Bannatyne Ave.	CS	1500
RR-87	Chelsea Pl	LDS	2260
SE-34	Rue Archibald St.	LDS	2700
SE-4	Rue Notre Dame W.	LDS	1220

APPENDIX E
Outfalls Not Inspected

APPENDIX E

OUTFALLS NOT INSPECTED

Outfalls > 300 and < 1200 mm - Not Inspected

Outfall ID	Name	Type	Size	Comments
RR-11	Radcliffe	WWS	760	Debris at bottom of MH and outlet, could not televise
RR-21.1	Bishop Grandin Blvd. 4	LDS	750	Outlet totally submerged
RR-29	Victoria Cres. 2	LDS	750	Outlet is dry, MH chamber is submerged, something blocking line
RR-47	Eccles St.	CS	750	MH chamber submerged, sediment at outlet
RR-56	Water Ave.	CS	457	Outlet not found, flow visible from bank
RR-56.1	Water Ave. 2	CS	450	Outlet not found
RR-61	Lombard Ave.	CS	900	Outlet not found, flow visible from bank
RR-81	Elmwood Park	LDS	900	Cannot access MH in park
AS-31	Oakdale Dr.	LDS	600	Submerged
AS-32	McQuacker Dr.	LDS	1050	MH located west of bridge, not accessible due to snow
AS-67	Wellington cres at CNR Bridge	LDS	450	Curb inlet cannot televise
AS-86B	Maryland St.	CS	600	Invert submerged 300 mm
SE-10	Rue Bourgeault	LDS	450	50 % submerged
SE-35	Avondale Rd.	LDS	750	Invert totally submerged
SE-40	Fernwood Ave.	LDS	750	Invert submerged 300 mm
SE-41	Clayton Dr.	LDS	525	Outlet totally submerged
SE-42	Berrydale Ave.	LDS	600	Invert submerged 300 mm
SE-44	Sadler Ave.	LDS	1066	Invert submerged 400 mm
SE-45	Hindley Ave.	LDS	530	Invert submerged 500 mm
SE-46	Worthington Ave.	LDS	750	Outlet totally submerged
SE-49	Willowlake Cres.	LDS	1050	Invert submerged. 600 mm
SE-50	N. of Beaverhill Blvd.	LDS	900	Outlet totally submerged
SE-52	Bishop Grandin Blvd.	LDS	800	Invert submerged 800 mm
SE-53.1	Royalwood Subdivision	LDS	450	Outlet submerged
BU-6.1	Delbrook Cres. 2	LDS	600	Outlet totally submerged
BU-7	Bonner Ave. 1	LDS	400	Outlet totally submerged
BU-8	Bonner Ave. 2	LDS	375	Outlet totally submerged
BU-16	Gateway Rd.	LDS	800	Outlet totally submerged in retention pond
BU-21	Sunny Hills Rd.	LDS	725	Outlet totally submerged in retention pond
BU-23	Mallows Way	LDS	900	Outlet totally submerged in retention pond
ST-1	Old Mill Rd.	LDS	400	Submerged
ST-7.1	Greenway Cres. 2	LDS	750	Invert submerged 300 mm
ST-18.1	Ness Ave.	LDS	400	Outlet totally submerged
ST-13	Alcott	WWS	600	50% sediment build-up in pipe

Outfalls > 1200 mm - Not Inspected

Outfall ID	Name	Type	Size	Comments
RR-14	SEWPCC Outfall	TS	1800	Will not be inspected internally
RR-16	Gateway Rd.	LDS	2280	Invert submerged 1000 mm
RR-32.5	Fermor Ave.	LDS	1950	Submerged
RR-39.7	St. Vital Bridge	LDS	1600	Outlet totally submerged
RR-47.1	Eccles St. at Churchill Dr.	LDS	1200	Invert submerged 800 mm and sediment build up at outlet
RR-47.5	Churchill High School	LDS	1600	Invert submerged 600 mm
RR-62	McDermot Ave.	CS	2700	Sediment build up
RR-64	Galt Ave. FPS	CS	1500	Invert submerged 1200 mm
RR-85	Inkster Blvd.	CS	2900	Invert submerged 1200 mm
RR-93	Rossmere Cres.	LDS	2900	Invert submerged 2000 mm
RR-99	NEWPCC Outfall Kildonan Golf Course	TS	3352x1200	Will not be inspected internally
RR-106	Summerview Lane	LDS	1800	Submerged
AS-1	WEWPCC Outfall	TS	1500	WEWPCC - Outfall will not be inspected internally
AS-24	Fairmont	LDS	2500	Invert submerged 1100 mm
AS-34	Olive St. 2	LDS	2200	Invert submerged 1100 mm
AS-59	Ferry Rd.	CS	1800	Invert submerged 600 mm and gate chamber bolted shut
AS-72	Renfrew St.	LDS	2400	Invert submerged 1200 mm
AS-77	Ash St.	CS	3048	Invert submerged 800 mm
AS-79	Aubrey St.	CS	2900x2300	Invert submerged
AS-82	Ruby St. 2	CS	2700	Invert submerged and MH locked
AS-85	Canora St.	CS	1980	Invert submerged and MH locked
AS-89	Spence St.	CS	2700	Outlet totally submerged
AS-92	Fort Rouge Park	CS	2400	Invert submerged 1200 mm
AS-97	The Forks E. of C.N.R. Bridge	LDS	1200	Invert submerged 600 mm and sediment build up
AS-99	Mayfair Ave.	WWS	1200	Invert submerged 600 mm
SE-48	Willowlake Cres.	LDS	1525	Outlet totally submerged
SE-51	Lavelee Rd.	LDS	1220	Invert submerged 800 mm
SE-53	Richfield Ave.	LDS	1200	Invert submerged 600 mm
SE-54	Public Lane E. of Meadowood Dr.	LDS	1200	Invert submerged 800 mm
SE-55	N. of John Bruce Rd.	LDS	1200	Invert submerged 600 mm
SE-56	Woodydell	LDS	1200	Invert submerged 1000 mm
SE-57	Compark	LDS	1400	Invert submerged 1000 mm
SE-58	Southglen	LDS	1600	Invert submerged 800 mm
SE-58.1	St. Annes Rd.	LDS	2-1600x1120	Invert submerged 1000 mm
BU-4	Rothesay St. N.	LDS	1200	Invert submerged 600 mm
BU-5	Rothesay St. S.	LDS	1200	Invert submerged 600 mm
BU-18	Jim Smith Dr.	LDS	1390x970	Outlet totally submerged in retention pond
BU-20	Sun Valley Dr.	LDS	1800	Outlet totally submerged in retention pond
BU-22	Wpg. Hydro Transmission Line	LDS	2125	Outlet totally submerged in retention pond
ST-4	Sturgeon Rd. (north)	LDS	1500	Invert submerged 750 mm & bank collapsed
ST-5	Sturgeon Rd. (south)	LDS	1200	Outlet totally submerged
ST-14	Ness Ave.	LDS	1900	Invert submerged 950 mm
OM-2	Clifton St. Overflow	CS	2700	Inv. sub. 800 mm

APPENDIX F
Outfall Inspection
Video Tape Index

APPENDIX F

OUTFALL INSPECTION VIDEO TAPE INDEX

ASSINIBOINE RIVER

Name	Outfall ID	Type	Size	Tape	Count
Arbuthnot	AS-87	CS	1400	3	1:20:10 - 1:27:30
Arlington St. 1	AS-83	CS	375	11	1:08:06 - 1:14:56
Ash St FPS	AS-76	CS	2100	3	1:51:01 - 2:00:42
Assiniboine Ave. - FPD	AS-95	CS	1350	6	2:14:43 - 2:27:56
				7	0:00:00 - 0:03:59
Aubrey St. FPS	AS-80	CS	2850	4	0:18:25 - 0:24:28
Barker Bvld.	AS-11	LDS	1075	14	0:26:06 - 0:27:34
Carroll Rd.	AS-19	LDS	1800	8	0:37:10 - 0:44:00
Chataway Blvd.	AS-60	CS	900	14	0:27:35 - 0:31:12
Chataway Blvd. 2	AS-60B	LDS	600		Visual
Clifton St.	AS-75	CS	2300	4	0:24:28 - 0:32:08
Clifton St. FPD	AS-74	CS	2100	8	1:47:22 - 1:55:59
Coleridge Park Dr. South	AS-14	LDS	450	11	0:19:28 - 0:25:03
Colony St.	AS-90	CS	1800	7	0:04:02 - 0:15:50
Conway CS	AS-42	CS	2500	4	0:44:27 - 0:57:20
Cornish Ave FPS	AS-86	CS	1600	7	0:38:37 - 0:57:25
Cornish St. 2	AS-88	CS	1500	7	0:22:45 - 0:38:37
Country Club Blvd.	AS-28	LDS	900	11	0:33:08 - 0:40:55
Dieppe Rd.	AS-23	WWS	650	12	1:02:53 - 1:04:00
Dieppe Rd. 2	AS-23.1	WWS	900	17	0:04:58 - 0:10:01
Donald St.	AS-94	CS	1900	2	1:17:10 - 1:25:34
Doncaster St.	AS-61	CS	2250	3	1:27:38 - 1:36:24
Douglas Park Rd.	AS-57	CS	300	11	0:47:09 - 0:47:42
Edgeland Blvd.	AS-61A	LDS	400	14	0:42:38 - 0:43:55
Elm St.	AS-78	CS	762	12	1:04:00 - 1:11:58
Empress Street	AS-70	LDS	300	11	0:52:06 - 1:00:11
Empress Street 2	AS-71	LDS	300	11	1:00:11 - 1:08:06
Glasworthy Pl.	AS-12	LDS	450	11	0:14:21 - 0:19:38
Hargrave St.	AS-93	CS	700	11	1:23:07 - 1:30:40
Harstone Rd.	AS-22	LDS	450	12	0:53:42 - 1:02:53
Kennedy St.	AS-91	CS	760	11	1:14:56 - 1:23:07
King Edward St.	AS-66	LDS	650	14	0:31:13 - 0:34:09
Landoo Dr.	AS-21.5	LDS	900	12	0:49:13 - 0:53:42
				12	1:11:58 - 1:16:08
McCallum Cres.	AS-18	LDS	1350	3	1:43:13 - 1:51:00
Olive St.	AS-33	CS	750	11	0:40:55 - 0:47:09
Orchard Park	AS-16.5	LDS	600	12	0:40:32 - 0:49:13
P.T.H. 100 E. Side	AS-4	LDS	800	14	0:17:35 - 0:24:26
P.T.H. 100 E. Side	AS-5	LDS	1200	1	0:12:20 - 0:25:58
P.T.H. 100 E. Side	AS-5.1	LDS	1500	1	0:12:20 - 0:25:58
P.T.H. 100 W. Side	AS-2	LDS	1400	4	1:01:39 - 1:05:52
P.T.H. 100 W. Side	AS-3	LDS	1200	1	0:06:00 - 0:12:20
Paradise Bay	AS-15	LDS	600	12	0:33:19 - 0:40:32
Park Bvld.	AS-58	LDS	2400	8	0:16:02 - 0:21:15
Parkside Dr.	AS-62	CS	750	11	0:47:42 - 0:52:06
				11	1:30:40 - 1:39:11

ASSINIBOINE RIVER

Name	Outfall ID	Type	Size	Tape	Count
Pender St.	AS-10	LDS	900	14	0:24:27 - 0:26:05
Raquette St. 2	AS-16.1	LDS	1800	8	1:55:59 - 2:07:26
Ridgedale Cres.	AS-27	LDS	450	12	0:05:04 - 0:12:34
Ridgedale S.P.S.	AS-26	WWS	250	12	0:17:59 - 0:25:55
Riverbend Cres.	AS-63	CS	2340	8	0:07:15 - 0:15:55
Route 90 Bridge	AS-67A	LDS	450	14	0:40:14 - 0:42:37
Ruby St. 1	AS-81	CS	2100	8	1:11:02 - 1:20:48
Sheir Dr.	AS-9.9	WWS	250	12	0:25:55 - 0:33:19
Shenfield Rd.	AS-25	LDS	450	12	0:12:34 - 0:17:59
St. Charles St. 1	AS-8	WWS	250	11	0:00:00 - 0:08:13
St. Charles St. 2	AS-9	LDS	900	11	0:08:14 - 0:14:21
St. James Underpass	AS-65	LDS	900	11	1:48:09 - end
Strathmillan Rd.	AS-37	CS	900	11	1:39:11 - 1:48:09
Tylehurst St.	AS-69	CS	2300	4	0:32:26 - 0:38:48
Vialoux Dr.	AS-35	LDS	1500	3	1:36:24 - 1:43:13
Vialoux Dr. Cul-de-Sac	AS-38	LDS	750	12	0:00:00 - 0:05:04
Wellington Cres. 2	AS-66.8	LDS	450	14	0:38:42 - 0:40:13
Wellington Cresc.	AS-68	LDS	500	16	0:00:00 - 0:08:52
WEWPCC Outfall	AS-1	TS	1500	1	0:00:00 - 0:06:00
Willow Ridge Rd.	AS-13	LDS	1800	3	2:04:06 - 2:19:41
Woodhaven Blvd.	AS-29	CS	450	11	0:25:08 - 0:33:08

RED RIVER

Name	Outfall ID	Type	Size	Tape	Count
Archibald Underpass	RR-68	LDS	750	10	1:04:38 - 1:08:58
				16	0:51:50 - 0:54:45
Armstrong Ave.	RR-95	CS	2700	3	0:20:36 - 0:26:12
Baltimore St. FPS	RR-45	CS	1800	8	0:44:17 - 0:51:51
Bannatyne Ave.	RR-63	CS	1500	16	0:47:47 - 0:51:49
Banning Rd.	RR-19	LDS	1370	2	0:38:56 - 0:44:17
Bishop Grandin Blvd. 2	RR-21	LDS	750	16	0:15:21 - 0:19:00
Bredin Dr.	RR-82	LDS	450	9	0:18:49 - 0:25:01
Burrows Ave.	RR-76	CS	2400		not televised
Calrossie Blvd.	RR-37	CS	450	10	0:17:15 - 0:21:12
Chelsea Pl	RR-87	LDS	2260	8	1:01:01 - 1:09:14
Churchill Dr. Underpass	RR-41	LDS	800	10	0:10:37 - 0:17:15
Cockburn St. FPS	RR-38	CS	1500	2	0:54:46 - 1:05:19
Cockburn St. Lift Station Outfall	RR-39	CS	1800	1	0:55:19 - 1:03:10
Crane Ave.	RR-26	CS	600	9	0:39:31 - 0:46:45
Crane Ave. Outfall	RR-27	CS	900	9	0:32:26 - 0:39:31
Darcy Dr.	RR-20	CS	2200	2	0:44:19 - 0:54:46
Disraeli Bridge	RR-73	LDS	300	9	0:15:49 - 0:17:39
Dowker Ave. Outfall	RR-28	LDS	900	10	0:55:15 - 1:04:38
Dunham Rd. Outfall	RR-33	LDS	1200	16	0:54:46 - 1:01:16
Dunkirk Dr.	RR-31	LDS	1400	2	0:15:26 - 0:24:31
Eastwood Dr.	RR-108	LDS	525	10	1:22:43 - 1:32:25
Edinburgh St.	RR-42	CS	800	10	0:07:02 - 0:10:37
Falconer Bay	RR-24	LDS	1200	6	0:29:57 - 0:38:33
				15	0:00:00 - 0:09:29
Glasgow Ave.	RR-48	LDS	1200	3	0:35:30 - 0:40:23
Glenview Ave.	RR-32	LDS	525	10	0:00:00 - 0:05:11
Grandmont Blvd.	RR-6	WWS	750	16	0:34:14 - 0:47:46
Hart Ave.	RR-79	CS	2850	6	0:47:13 - 0:58:14
				8	0:51:51 - 1:00:49
Hawthorne Ave.	RR-98	CS	2200	2	1:05:19 - 1:17:10
Henderson Hwy. (Private)	RR-105	LDS	600	10	1:19:20 - 1:22:43
Jefferson Ave.	RR-88	CS	3300	5	1:10:42 - 1:20:22
Jessie Ave	RR-49	CS	1900	7	1:04:09 - 1:14:40
John Black Ave.	RR-101	LDS	1800		not televised
Kildonan Park #1	RR-97	LDS	250	9	0:17:39 - 0:18:49
Killarney St.	RR-43	LDS	1200	7	0:57:25 - 1:04:09
				10	0:31:34 - 0:37:13
Kings Dr.	RR-12	LDS	1500	5	1:36:12 - 1:45:41
Kingston Row Underpass	RR-40	LDS	750	10	0:05:11 - 0:07:02
Larchdale Cres. SPS	RR-96	LDS	1050	10	1:14:24 - 1:19:20
Lemay Ave.	RR-2	LDS	900	9	0:25:01 - 0:29:30
Linden Ave.	RR-90	CS	1800	5	0:00:03 - 0:33:32
Linden Ave. - Flood Pump Discharge	RR-91	CS	1675	5	0:33:32 - 0:54:57
Lotus Lane	RR-30	LDS	600	10	0:21:12 - 0:31:34
Mager St. FPS	RR-44	LDS	1800	6	1:23:37 - 1:39:56

RED RIVER

Name	Outfall ID	Type	Size	Tape	Count
Marion St. 2	RR-52	CS	1800	1	0:26:13 - 0:55:13
Marion St. FPD	RR-51	CS	1600	1	0:26:13 - 0:55:13
Metcalfe Pl.	RR-46	CS	2000	6	1:13:43 - 1:23:29
Minnetonka	RR-17	LDS	2100	6	0:12:15 - 0:29:57
Moore Ave.	RR-25	LDS	1100	6	0:38:33 - 0:47:00
Munroe Ave. FPS	RR-84	CS	2500	4	1:05:56 - 1:09:04
Newton Ave.	RR-94	CS	1850	5	1:20:22 - 1:27:00
Oakcrest Pl.	RR-34	LDS	375	10	0:37:13 - 0:45:05
Park Dr.	RR-50.5	LDS	1200	16	1:10:53 - 1:20:13
Perimeter Hwy. at Cloutier Dr.	RR-7	CS	1800	3	0:00:00 - 0:20:36
Plaza Dr.	RR-22	LDS	2400	5	1:27:03 - 1:36:11
Polson Ave. FPS	RR-83	CS	1800	3	0:26:15 - 0:35:28
Pritchard Ave.	RR-75	CS	250	9	0:00:00 - 0:11:45
Radcliffe 1	RR-10	LDS	1200	3	1:07:58 - 1:20:00
Red River Blvd.	RR-104	LDS	750	10	1:32:25 - 1:50:21
Rice Dr.	RR-9	LDS	1500	5	1:45:43 - 2:03:29
River Pointe Pl.	RR-18	LDS	1050	16	0:24:00 - 0:30:51
Riverdale Ave.	RR-34.8	LDS	600	16	0:19:01 - 0:23:59
Rivergate Dr.	RR-15	WWS	1350	2	0:30:06 - 0:38:52
Riviera Cres. Outfall	RR-23	LDS	2000	3	0:56:06 - 1:07:58
Rue Despins	RR-54	CS	1400	6	1:39:56 - 1:51:06
Rue Despins FPD	RR-55	CS	1200	1	1:09:40 - 1:27:36
Rue Dumoulin 2	RR-57	CS	1200	1	1:30:57 - 1:49:04
Rue Dumoulin 3	RR-58	CS	1060	9	0:11:45 - 0:15:49
				6	1:51:09 - 2:07:56
Rue La Verendrye	RR-59	CS	1200	8	1:20:48 - 1:30:02
Rue La Verendrye FPS	RR-60	CS	600	10	1:08:58 - 1:14:24
Selkirk Ave.	RR-74	CS	1800	5	1:00:18 - 1:10:42
Somerset Ave.	RR-36	CS	1800	3	0:40:23 - 0:56:06
St. John's Park MH	RR-80	CS	3000	7	1:34:38 - 1:42:38
St. Norbert X-Kalay Lift Station Overflow	RR-3	WWS	300	9	0:29:30 - 0:32:26
Stormont Dr.	RR-8	LDS	400	16	0:30:52 - 0:34:13
Syndicate St. - Flood Pump Discharge	RR-71	CS	1800	2	0:07:32 - 0:15:25
Valhalla Dr.	RR-103	LDS	1675	6	0:58:14 - 1:13:43
Watt St.	RR-70	CS	3700	7	1:16:03 - 1:34:38
Watt St. 2 (connector pipe)	RR-70.1	CS	1500	7	1:16:03 - 1:34:38
Watt St. 3 (connector pipe)	RR-70.2	CS	1850	7	1:16:03 - 1:34:38
Watt St. 4 (connector pipe)	RR-70.3	CS	1250	7	1:16:03 - 1:34:38
Whellams Lane	RR-100	WWS	1200	6	0:05:48 - 0:12:07
Wildwood Golf Coarse	RR-35	CS	900	10	0:45:05 - 0:55:15

SEINE RIVER

Name	Outfall ID	Type	Size	Tape	Count
Blenheim Ave.	SE-31	LDS	1060	13	0:08:49 - 0:10:30
Comanche Rd.	SE-36	WWS	600	13	1:59:16 - 2:00:37
Cote St.	SE-28	WWS	450	13	0:25:09 - 0:33:03
Egerton Rd.	SE-30.1	LDS	900	13	0:10:31 - 0:13:36
Evans Ave.	SE-27	LDS	1067	13	0:20:51 - 0:22:55
Fermor Ave.	SE-37	LDS	600	13	0:15:03 - 0:16:27
Gareau St.	SE-29	LDS	800	13	0:18:44 - 0:20:50
Guay Ave.	SE-30	LDS	750	13	0:13:37 - 0:15:02
Humbolt Ave.	SE-33	LDS	900	13	0:02:44 - 0:06:00
Imperial Ave.	SE-32	LDS	750	13	0:06:01 - 0:08:48
Kavanagh St.	SE-12	LDS	750	13	0:33:04 - 0:36:14
Marlene St.	SE-47	LDS	530	14	0:00:00 - 0:02:28
Mission FPS	SE-1	CS	2600	3	2:19:45 - 2:32:51
Morrow Ave.	SE-39	LDS	750	18	0:00:00 - end
Niakwa Rd. 1	SE-38	LDS	450	13	0:00:00 - 0:02:43
Niakwa Rd. 2	SE-38.1	LDS	450	17	0:23:21 - 0:27:35
Rue Archibald St.	SE-34	LDS	2700	8	2:07:26 - 2:18:40
Rue Dumoulin	SE-5	WWS	600	14	0:02:29 - 0:04:49
Rue Laverendrye	SE-2	LDS	600	14	0:04:50 - 0:06:01
Rue Notre Dame W.	SE-4	LDS	1220	17	0:15:26 - 0:23:20
Southbridge Dr.	SE-43	LDS	900	13	0:16:28 - 0:18:43
St. Catherine St. 1	SE-21	LDS	600	13	0:22:56 - 0:25:08

BUNNS CREEK

Name	Outfall ID	Type	Size	Tape	Count
Bonner Ave.	BU-3	LDS	525	13	0:41:26 - 0:43:08
Delbrook Cres.	BU-6	LDS	400	16	1:01:17 - 1:02:57
Henderson Hwy.	BU-1	LDS	1375	3	2:34:33 - 2:44:00
Henderson Hwy. 2	BU-2	LDS	1200	3	2:44:00 - 2:53:10
McIvor Ave.	BU-12	LDS	400	13	0:36:15 - 0:37:37
Pennefather St.	BU-9	LDS	1350	17	0:10:02 - 0:15:25
Raleigh St. 1	BU-13	LDS	400	13	1:48:20 - 1:49:40
Raleigh St. 2	BU-14	LDS	750	13	0:39:55 - 0:41:25
Raleigh St. 3	BU-15	LDS	750	13	1:49:41 - 1:59:15
Uxbridge Rd. N.	BU-10	LDS	1200	2	0:00:00 - 0:05:27
Uxbridge Rd. S.	BU-11	LDS	900	13	0:37:38 - 0:39:54

OMAND'S CREEK

Name	Outfall ID	Type	Size	Tape	Count
Empress St. 1	OM-3	LDS	750	16	1:02:58 - 1:09:42
Raglan Rd.	OM-1	LDS	400	14	0:43:56 - 0:46:41
Velodrome 1	OM-4	LDS	380	16	1:09:43 - 1:10:52

STURGEON CREEK

Name	Outfall ID	Type	Size	Tape	Count
Acheson Dr.	ST-23	LDS	900	13	1:35:07 - 1:43:28
Amarynth Cres.	ST-9	LDS	525	13	0:56:47 - 1:03:00
Amarynth Cres. 2	ST-12	LDS	400	13	1:03:01 - 1:04:57
Booth Dr.	ST-3	LDS	1850	8	0:28:48 - 0:36:53
Crestview Park Dr.	ST-22	LDS	762	13	1:31:54 - 1:33:31
Crestview Park Dr. (pond drainage)	ST-21	LDS	1676	8	0:00:15 - 0:07:11
Greenway Cres.	ST-7	LDS	600	14	0:10:52 - 0:17:34
Hamilton Ave.	ST-18	LDS	1500	8	0:23:18 - 0:28:48
Harvest Lane	ST-17	LDS	400	13	1:12:06 - 1:17:41
Kirby Dr.	ST-11	LDS	600	13	1:04:58 - 1:07:05
Lonsdale Dr.	ST-8	LDS	600	13	0:51:02 - 0:56:46
Saskatchewan Ave.	ST-24	LDS	361	13	1:33:32 - 1:35:06
Setter St.	ST-6	LDS	600	13	0:43:09 - 0:51:01
Silver Ave.	ST-19	WWS	525	13	1:17:42 - 1:30:04
Valleyview Dr. 1	ST-15	WWS	600	13	1:07:06 - 1:10:46
Valleyview Dr. 2	ST-16	LDS	1050	13	1:43:29 - 1:48:19
Voyageur	ST-20	WWS	600	13	1:30:05 - 1:31:53

LaSALLE RIVER

Name	Outfall ID	Type	Size	Tape	Count
La Maire Ave.	LS-4	LDS	1000	16	0:12:02 - 0:15:20
Rue Des Trappistes	LS-2	LDS	450	14	0:06:02 - 0:10:51

FLOODWAY

Name	Outfall ID	Type	Size	Tape	Count
Deacon Reservoir	FL-1	LDS	1500	8	1:30:02 - 1:38:32
Kildare at Floodway	FL-2	LDS	3000	8	1:38:34 - 1:47:13

APPENDIX G
Detail Cost Estimate

Outfall ID#	NAME	Pipe size (mm)	Access	Pipe Length - Concrete Pipe (m)	Pipe Length - CMP (m)	Pipe Cost - Concrete Pipe ($/m)[1]	Total Concrete Pipe cost	Pipe Cost - CMP ($/m)[1]	Total CMP cost	Surface Condition	Restoration	Sub-Total	Engineering 14%	Overhead 7%	Contingencies 10%	Total Estimated Cost For Pipe Repairs	Total Estimated Cost For Erosion Protection	Total Estimated Cost	Comments
Pumping Stations and Flood Pumping Stations																			
AS 74	Clifton Street FPD	2100	$ 7,500		35	$2,410	$ -	$1,060	$ 37,100	sod	$ 3,000	$ 47,600	$ 6,664	$ 3,332	$ 4,760	$ 62,000	$ 10,000	$ 72,000	Requires Rip Rap
RR 51	Marion Street FPD	1600	$ 5,000		34			$830	$ 28,220	sod	$ 3,000	$ 36,220	$ 5,071	$ 2,535	$ 3,622	$ 47,000	$ 10,000	$ 57,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 55	Rue Despins FPD	1200	$ 5,000		34			$600	$ 20,400	sod	$ 3,000	$ 28,400	$ 3,976	$ 1,988	$ 2,840	$ 37,000	$ 10,000	$ 47,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 60	Rue La Verendrye	600	$ 5,000		8	$190	$ -	$170	$ 1,360	scrub grass	$ 1,000	$ 7,360	$ 1,030	$ 515	$ 736	$ 10,000	$ 25,000	$ 35,000	"Spot" repair 5 m; Pipe has shifted. Requires Rip Rap
	Subtotal															$ 156,000	$ 55,000	$ 211,000	
Waste Water Sewer Overflow																			
RR 100	Whellams Lane	1200	$ 7,500			$770	$ -	$600	$ -	scrub		$ 7,500	$ 1,050	$ 525	$ 750	$ 10,000	$ 10,000	$ 20,000	Requires Rip Rap
AS 23	Dieppe Road	650	$ 5,000			$190	$ -	$170	$ -	sod		$ 5,000	$ 700	$ 350	$ 500	$ 7,000	$ 5,000	$ 12,000	Incomplete inspection another cmp runs through pipe. Requires Rip Rap
RR 3	St. Norbert X-Kalay Lift Station Overflow	300	$ 7,500	20	5	$90	$ 1,800	$75	$ 375	trees and bush	$ 1,500	$ 11,175	$ 1,565	$ 782	$ 1,118	$ 15,000	$ 10,000	$ 25,000	Requires Rip Rap
AS 9.9	Sheir Dr.	250			47.5	$50	$ -	$60	$ 2,850	assume sod	$ 2,500	$ 5,350	$ 749	$ 375	$ 535	$ 7,000		$ 7,000	
AS 26	Ridgedale S.P.S.	250	$ 5,000		10	$50	$ -	$60	$ 600	assume sod	$ 2,500	$ 8,100	$ 1,134	$ 567	$ 810	$ 11,000		$ 11,000	"Spot" repair 10 m; Side of CMP pushed in
AS 8	St. Charles Street 1	250		70.7		$50	$ 3,535			assume sod	$ 2,500	$ 6,035	$ 845	$ 422	$ 604	$ 8,000		$ 8,000	
	Subtotal															$ 58,000	$ 25,000	$ 83,000	
Combined Sewer Overflow																			
RR 79	Hart Ave	2850	$ 5,000		37	$4,200	$ -	$1,430	$ 52,910	trees and bush	$ 1,500	$ 59,410	$ 8,317	$ 4,159	$ 5,941	$ 78,000	$ 25,000	$ 103,000	Requires Rip Rap
AS 42	Conway CS	2500	$ 5,000	62.5	15	$3,060	$ 191,250	$1,280	$ 19,200	sod		$ 215,450	$30,163	$ 15,082	$ 21,545	$ 282,000	$ 50,000	$ 332,000	Requires Rip Rap
AS 61	Doncastor Street	2250	$ 5,000	40	5	$2,410	$ 96,400	$1,180	$ 5,900	assume sod	$ 3,500	$ 110,800	$15,512	$ 7,756	$ 11,080	$ 145,000	$ 25,000	$ 170,000	Requires Rip Rap
AS 81	Ruby St. 1	2100	$ 5,000		30	$2,410	$ -	$1,060	$ 31,800	sod	$ 2,500	$ 39,300	$ 5,502	$ 2,751	$ 3,930	$ 51,000	$ 10,000	$ 61,000	Requires Rip Rap
AS 90	Colony Street	1800	$ 5,000	22	15	$1,680	$ 36,960	$930	$ 13,950	sod	$ 1,875	$ 57,785	$ 8,090	$ 4,045	$ 5,779	$ 76,000	$ 25,000	$ 101,000	Requires Rip Rap
RR 52	Marion Street	1800	$ 5,000		41			$930	$ 38,130	sod	$ 2,500	$ 45,630	$ 6,388	$ 3,194	$ 4,563	$ 60,000	$ 10,000	$ 70,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 90	Linden Ave.	1800	$ 5,000	10		$1,680	$ 16,800	$930	$ -	scrub grass	$ 1,000	$ 22,800	$ 3,192	$ 1,596	$ 2,280	$ 30,000	$ 5,000	$ 35,000	Requires Rip Rap
RR 54	Rue Despins	1400		13	22	$970	$ 12,610	$730	$ 16,060	sod	$ 2,500	$ 31,170	$ 4,364	$ 2,182	$ 3,117	$ 41,000	$ 5,000	$ 46,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 58	Rue Doumoulin	1060	$ 5,000		37	$590	$ -	$380	$ 14,060	sod	$ 3,000	$ 22,060	$ 3,088	$ 1,544	$ 2,206	$ 29,000	$ 5,000	$ 34,000	Replacement cost only. Pricing is subject to replacement as part of the Future Provencher Bridge project. Requires Rip Rap
RR 96	Larchdale Cres. SPS	1050	$ 5,000	12	3	$590	$ 7,080	$380	$ 1,140	scrub grass	$ 1,000	$ 14,220	$ 1,991	$ 995	$ 1,422	$ 19,000	$ 10,000	$ 29,000	Requires Rip Rap
AS 37	Strathmillan Road	900	$ 5,000	15	15	$410	$ 6,150	$250	$ 3,750	sod	$ 2,500	$ 17,400	$ 2,436	$ 1,218	$ 1,740	$ 23,000	$ 25,000	$ 48,000	Outfall is Submerged. Requires Rip Rap
AS 91	Kennedy Street	760	$ 15,000	10	10	$250	$ 2,500	$210	$ 2,100	riverwalk and rip rap	$ 7,500	$ 27,100	$ 3,794	$ 1,897	$ 2,710	$ 36,000		$ 36,000	
AS 93	Hargrave Street	700	$ 15,000		5	$190	$ -	$170	$ 850	rip rap	$ 2,500	$ 18,350	$ 2,569	$ 1,285	$ 1,835	$ 24,000		$ 24,000	"Spot" repair 5 m; Pipe has shifted
AS 29	Woodhaven Blvd.	450	$ 15,000	70		$140	$ 9,800	$100	$ -	sod	$ 4,000	$ 28,800	$ 4,032	$ 2,016	$ 2,880	$ 38,000	$ 5,000	$ 43,000	Requires Rip Rap
RR 37	Calrossie Blvd	450	$ 7,500		20	$140	$ -	$100	$ 2,000	scrub grass	$ 1,000	$ 10,500	$ 1,470	$ 735	$ 1,050	$ 14,000	$ 10,000	$ 24,000	Requires Rip Rap
AS 83	Arlington Street 1	375	$ 5,000		35	$100	$ -	$75	$ 2,625	scrub grass	$ 1,500	$ 9,125	$ 1,278	$ 639	$ 913	$ 12,000		$ 12,000	Includes an extra 15m section to extend outfall into the river
	Subtotal															$ 958,000	$ 210,000	$ 1,168,000	
Land Drainage Sewer																			
FL 2	Kildare at Floodway	3000	$ 5,000	45		$4,200	$ 189,000	$1,600	$ -	scrub grass	$ 2,000	$ 196,000	$27,440	$ 13,720	$ 19,600	$ 257,000	$ 25,000	$ 282,000	Requires Rip Rap
ST 3	Booth Drive	1850	$ 5,000	5	7	$1,680	$ 8,400	$930	$ 6,510	sod	$ 1,500	$ 21,410	$ 2,997	$ 1,499	$ 2,141	$ 28,000	$ 5,000	$ 33,000	Requires Rip Rap
AS 16.1	Raquette street 2	1800	$ 5,000	20		$1,680	$ 33,600	$930	$ -	sod		$ 38,600	$ 5,404	$ 2,702	$ 3,860	$ 51,000	$ 5,000	$ 56,000	Requires Rip Rap
AS 19	Carroll Road	1800	$ 5,000		75	$1,680	$ -	$930	$ 69,750	sod	$ 5,250	$ 80,000	$11,200	$ 5,600	$ 8,000	$ 105,000	$ 30,000	$ 135,000	Requires Rip Rap
RR 7	Cloutier Drive (Segment 1 & 2)	1800/900	$ 5,000		5/40		$ -	$930/$600	$ 28,650	trees and bush	$ 3,000	$ 36,650	$ 5,131	$ 2,566	$ 3,665	$ 48,000	$ 10,000	$ 58,000	"Spot" repair 5 m on Segment 1. Requires Rip Rap Repairs
RR 103	Valhalla Drive	1675	$ 10,000		25	$1,400	$ -	$830	$ 20,750	asphalt parking lot	$ 7,500	$ 38,250	$ 5,355	$ 2,678	$ 3,825	$ 50,000	$ 10,000	$ 60,000	Requires Rip Rap
FL 1	Deacon Reservoir	1500	$ 5,000			$1,170	$ 15,000	$730	$ -	scrub grass	$ 2,000	$ 22,000	$ 3,080	$ 1,540	$ 2,200	$ 29,000		$ 29,000	Majority of the joints have started to separate, some > 25mm, Assume $15,000 to grout shifted joints
RR 31	Dunkirk Drive	1400	$ 5,000		15	$970	$ -	$730	$ 10,950	grass	$ 1,500	$ 17,450	$ 2,443	$ 1,222	$ 1,745	$ 23,000	$ 20,000	$ 43,000	Requires Rip Rap
AS 18	McCallum Cres.	1350	$ 5,000		5	$970	$ -	$600	$ 3,000	sod	$ 1,500	$ 9,500	$ 1,330	$ 665	$ 950	$ 12,000		$ 12,000	"Spot" repair 5 m; Outlet is damaged
RR 59	Rue La Verendrye	1200	$ 5,000	25	2	$770	$ 19,250	$600	$ 1,200	scrub and bush	$ 1,000	$ 26,450	$ 3,703	$ 1,852	$ 2,645	$ 35,000	$ 25,000	$ 60,000	Requires Rip Rap
AS 10	Pender Street	900	$ 5,000		5	$410	$ -	$250	$ 1,250	trees and scrub grass	$ 3,000	$ 9,250	$ 1,295	$ 648	$ 925	$ 12,000		$ 12,000	"Spot" repair 5 m; Pipe outlet has some ice damage
RR 28	Dowker Ave. Outfall	900	$ 7,500		6	$410	$ -	$250	$ 1,500	trees and brush	$ 1,000	$ 10,000	$ 1,400	$ 700	$ 1,000	$ 13,000	$ 10,000	$ 23,000	Requires Rip Rap
RR 68	Archibald Underpass	750	$ 15,000	5		$250	$ 1,250	$210	$ -	scrub grass	$ 1,000	$ 17,250	$ 2,415	$ 1,208	$ 1,725	$ 23,000		$ 23,000	"Spot" repair 5 m; Pipe has shifted; Outfall is Submerged
AS 38	Vialoux Drive Cul-de-Sac	750	$ 15,000	20		$250	$ 5,000	$210	$ -	scrub grass	$ 1,500	$ 21,500	$ 3,010	$ 1,505	$ 2,150	$ 28,000		$ 28,000	
OM 3	Empress Street 1	750	$ 5,000	45		$250	$ 11,250	$210	$ -	scrub grass	$ 2,000	$ 18,250	$ 2,555	$ 1,278	$ 1,825	$ 24,000		$ 24,000	
RR 104	Red River Blvd.	750	$ 5,000	50	31	$250	$ 12,500	$210	$ 6,510	scrub grass	$ 2,000	$ 26,010	$ 3,641	$ 1,821	$ 2,601	$ 34,000		$ 34,000	
RR 30	Lotus lane	600	$ 5,000		11	$190	$ -	$170	$ 1,870	scrub grass	$ 1,000	$ 7,870	$ 1,102	$ 551	$ 787	$ 10,000	$ 10,000	$ 20,000	Requires Rip Rap
SE 2	Rue Laverendrye	600	$ 5,000		5	$190	$ -	$170	$ 850	trees and bush	$ 1,000	$ 6,850	$ 959	$ 480	$ 685	$ 9,000		$ 9,000	"Spot" repair 5 m; Pipe has shifted
RR 41	Churchill Drive Underpass	525	$ 7,500	15		$190	$ 2,850	$100	$ -	sod		$ 10,350	$ 1,449	$ 725	$ 1,035	$ 14,000	$ 5,000	$ 19,000	Incomplete inspection too much sediment build-up. Requires Rip Rap
RR 108	Eastwood Drive	525	$ 10,000	46	10	$190	$ 8,740	$100	$ 1,000	scrub grass	$ 2,000	$ 21,740	$ 3,044	$ 1,522	$ 2,174	$ 28,000	$ 25,000	$ 53,000	Requires Rip Rap
AS 25	Shenfield Road	450	$ 15,000		50	$140	$ -	$100	$ 5,000	trees and bush	$ 1,500	$ 21,500	$ 3,010	$ 1,505	$ 2,150	$ 28,000	$ 5,000	$ 33,000	Requires Rip Rap
AS 27	Ridgedale Cres	450	$ 5,000	7	25	$140	$ 980	$100	$ 2,500	trees and bush	$ 1,000	$ 9,480	$ 1,327	$ 664	$ 948	$ 12,000		$ 12,000	
BU 6	Delbrook Cres.	400	$ 5,000		17	$100	$ -	$100	$ 1,700	sod	$ 1,500	$ 8,200	$ 1,148	$ 574	$ 820	$ 11,000		$ 11,000	Pipe collapsed incomplete inspection.
RR 8	Stormont Drive	400	$ 5,000		10	$100	$ -	$100	$ 1,000	scrub grass	$ 1,000	$ 7,000	$ 980	$ 490	$ 700	$ 9,000	$ 10,000	$ 19,000	Requires Rip Rap
ST 12	Amarynth Cres. 2	400	$ 10,000			$100	$ -	$100	$ -	sod		$ 10,000	$ 1,400	$ 700	$ 1,000	$ 13,000		$ 13,000	
ST 17	Harvest Lane	400	$ 10,000		16	$100	$ -	$100	$ 1,600	sod	$ 1,500	$ 13,100	$ 1,834	$ 917	$ 1,310	$ 17,000	$ 5,000	$ 22,000	Requires Rip Rap
OM 4	Veledrome 1	380	$ 5,000		6.1	$100	$ -	$75	$ 458	scrub grass	$ 1,000	$ 6,458	$ 904	$ 452	$ 646	$ 8,000	$ 25,000	$ 33,000	Pipe collapsed incomplete inspection. Requires Rip Rap
RR 34	Oakcrest Place	375	$ 7,500	37	20	$100	$ 3,700	$75	$ 1,500	scrub	$ 1,750	$ 14,450	$ 2,023	$ 1,012	$ 1,445	$ 19,000	$ 50,000	$ 69,000	Requires Rip Rap
AS 70	Empress Street	300	$ 10,000		10	$90	$ -	$75	$ 750	sod	$ 1,500	$ 12,250	$ 1,715	$ 858	$ 1,225	$ 16,000		$ 16,000	
	Subtotal															$ 966,000	$ 275,000	$ 1,241,000	
	TOTAL															$ 2,138,000	$ 565,000	$ 2,703,000	

APPENDIX G

DETAIL COST ESTIMATES
CAPITAL UPGRADES AND
ICE DAMAGE MAINTENANCE

Outfall ID#	NAME	Pipe si (mm)	al ated For ion tion	Total Estimated Cost	Comments
Pumping Stations and Flood Pumping Stations					
AS 74	Clifton Street FPD	2100	0,000	$ 72,000	Requires Rip Rap
RR 51	Marion Street FPD	1600	0,000	$ 57,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 55	Rue Despins FPD	1200	0,000	$ 47,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 60	Rue La Verendrye	600	5,000	$ 35,000	"Spot" repair 5 m; Pipe has shifted. Requires Rip Rap
	Subtotal		**5,000**	**$ 211,000**	
Waste Water Sewer Overflow					
RR 100	Whellams Lane	1200	0,000	$ 20,000	Requires Rip Rap
AS 23	Dieppe Road	650	5,000	$ 12,000	Incomplete inspection another cmp runs through pipe. Requires Rip Rap
RR 3	St. Norbert X-Kalay Lift Station Overflow	300	0,000	$ 25,000	Requires Rip Rap
AS 9.9	Sheir Dr.	250		$ 7,000	
AS 26	Ridgedale S.P.S.	250		$ 11,000	"Spot" repair 10 m; Side of CMP pushed in
AS 8	St. Charles Street 1	250		$ 8,000	
	Subtotal		**5,000**	**$ 83,000**	
Combined Sewer Overflow					
RR 79	Hart Ave	2850	5,000	$ 103,000	Requires Rip Rap
AS 42	Conway CS	2500	0,000	$ 332,000	Requires Rip Rap
AS 61	Doncastor Street	2250	5,000	$ 170,000	Requires Rip Rap
AS 81	Ruby St. 1	2100	0,000	$ 61,000	Requires Rip Rap
AS 90	Colony Street	1800	5,000	$ 101,000	Requires Rip Rap
RR 52	Marion Street	1800	0,000	$ 70,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 90	Linden Ave.	1800	5,000	$ 35,000	Requires Rip Rap
RR 54	Rue Despins	1400	5,000	$ 46,000	Replacement cost only. Pricing is subject to Combined Sewer Relief Study results. Requires Rip Rap
RR 58	Rue Doumoulin	1060	5,000	$ 34,000	Replacement cost only. Pricing is subject to replacement as part of the Future Provencher Bridge project. Requires Rip Rap
RR 96	Larchdale Cres. SPS	1050	0,000	$ 29,000	Requires Rip Rap
AS 37	Strathmillan Road	900	5,000	$ 48,000	Outfall is Submerged. Requires Rip Rap
AS 91	Kennedy Street	760		$ 36,000	
AS 93	Hargrave Street	700		$ 24,000	"Spot" repair 5 m; Pipe has shifted
AS 29	Woodhaven Blvd.	450	5,000	$ 43,000	Requires Rip Rap
RR 37	Calrossie Blvd	450	0,000	$ 24,000	Requires Rip Rap
AS 83	Arlington Street 1	375		$ 12,000	Includes an extra 15m section to extend outfall into the river
	Subtotal		**0,000**	**$ 1,168,000**	
Land Drainage Sewer					
FL 2	Kildare at Floodway	3000	5,000	$ 282,000	Requires Rip Rap
ST 3	Booth Drive	1850	5,000	$ 33,000	Requires Rip Rap
AS 16.1	Raquette street 2	1800	5,000	$ 56,000	Requires Rip Rap
AS 19	Carroll Road	1800	0,000	$ 135,000	Requires Rip Rap
RR 7	Cloutier Drive (Segment 1 & 2)	1800/90	0,000	$ 58,000	"Spot" repair 5 m on Segment 1. Requires Rip Rap Repairs
RR 103	Valhalla Drive	1675	0,000	$ 60,000	Requires Rip Rap
FL 1	Deacon Reservoir	1500		$ 29,000	Majority of the joints have started to separate, some > 25mm, Assume $15,000 to grout shifted joints
RR 31	Dunkirk Drive	1400	0,000	$ 43,000	Requires Rip Rap
AS 18	McCallum Cres.	1350		$ 12,000	"Spot" repair 5 m; Outlet is damaged
RR 59	Rue La Verendrye	1200	5,000	$ 60,000	Requires Rip Rap
AS 10	Pender Street	900		$ 12,000	"Spot" repair 5 m; Pipe outlet has some ice damage
RR 28	Dowker Ave. Outfall	900	0,000	$ 23,000	Requires Rip Rap
RR 68	Archibald Underpass	750		$ 23,000	"Spot" repair 5 m; Pipe has shifted; Outfall is Submerged
AS 38	Vialoux Drive Cul-de-Sac	750		$ 28,000	
OM 3	Empress Street 1	750		$ 24,000	
RR 104	Red River Blvd.	750		$ 34,000	
RR 30	Lotus lane	600	0,000	$ 20,000	Requires Rip Rap
SE 2	Rue Laverendrye	600		$ 9,000	"Spot" repair 5 m; Pipe has shifted
RR 41	Churchill Drive Underpass	525	5,000	$ 19,000	Incomplete inspection too much sediment build-up. Requires Rip Rap
RR 108	Eastwood Drive	525	5,000	$ 53,000	Requires Rip Rap
AS 25	Shenfield Road	450	5,000	$ 33,000	Requires Rip Rap
AS 27	Ridgedale Cres	450		$ 12,000	
BU 6	Delbrook Cres.	400		$ 11,000	Pipe collapsed incomplete inspection.
RR 8	Stormont Drive	400	0,000	$ 19,000	Requires Rip Rap
ST 12	Amarynth Cres. 2	400		$ 13,000	
ST 17	Harvest Lane	400	5,000	$ 22,000	Requires Rip Rap
OM 4	Veledrome 1	380	5,000	$ 33,000	Pipe collapsed incomplete inspection. Requires Rip Rap
RR 34	Oakcrest Place	375	0,000	$ 69,000	Requires Rip Rap
AS 70	Empress Street	300		$ 16,000	
	Subtotal		**5,000**	**$ 1,241,000**	
	TOTAL		**5,000**	**$ 2,703,000**	

Outfall: ST-16 Valleyview Dr. 2 1050 mm

Condition: Top of outlet bent, grating damaged and hanging open

Action: Straighten CMP and reinstall grate

Time: 4 hr.

Cost: $1,000.00

Outfall: AS-10 Pender St. 900 mm

Condition: Outlet bent, opening reduced by 50 %.

Action: Assume damaged portion can be removed or straightened.

Time: 1 day

Cost: $1,000.00

Outfall: AS-13 Willow Ridge Rd. 1800 mm

Condition: Outlet bent inwards and torn. Outlet extends from bank.

Action: trim and remove damaged CMP

Time: 1 day

Cost: $1,000.00

Outfall: AS-18 McCallum Cres. 1350 mm

Condition: CMP closed at outlet, opening reduced by 70%. Outlet extends from bank.

Action: trim and remove damaged CMP

Time: 1 day

Cost: $1,000.00

Outfall: AS-42 Conway CS 2500 mm

Condition: Top of CMP bent

Action: Straighten CMP

Time: 4 hr.

Cost: $1,000.00

Outfall: AS-61 Doncastor St. 2250 mm

Condition: CMP bent at outlet, extends from bank.

Action: trim and remove damaged CMP

Time: 1 day

Cost: $1,000.00

Outfall: AS-67 Wellington Cres. 450 mm

Condition: Top of CMP bent, extends from bank.

Action: trim and remove damaged CMP

Time: 1/2 to 1 day

Cost: $1,000.00

Outfall: AS-78 Elm St. 750 mm

Condition: CMP bent, opening reduced by 25 %.

Action: Assume damaged portion can be removed or straightened.

Time: 1 day

Cost: $1,000.00

Outfall: AS-88 Cornish St. 2 1500 mm

Condition: Grate bent and twisted.

Action: Remove existing grate and install new grate.

Time: 1/2 to 1 day

Cost: Labour $1,000.00 plus New Grate $3,000.00 = $4,000.00

Outfall: RR-100 Whellams Lane 1200 mm

Condition: Top of CMP flattened at end.

Action: Trim and remove damaged portion.

Time: 2 days (some excavation required around pipe).

Cost: Labour $1,000.00 plus Equipment $1,000.00 = $2,000.00

Outfall: RR-59 Rue La Verendrye 1200 mm

Condition: Upstream side of outlet pushed in.

Action: Trim and removed damaged CMP and grate. Install new grate.

Time: 1 to 2 days

Cost: Labour $1,000.00 plus Grate $2,500.00 = $3,500.00

Outfall: RR-60 Rue La Verendrye FPS 600 mm

Condition: CMP bent out of alignment.

Action: Trim and removed damaged CMP.

Time: 1 day

Cost: $1,000.00

Outfall: RR-79 Hart Ave. 2850x2130 mm

Condition: CMP bent and torn at outlet.

Action: Trim and remove damaged CMP.

Time: 1 day

Cost: $1,000.00

Outfall: RR-87 Chelsea Pl 2275mm

Condition: First joint from outlet open and displaced from 9:00 to 3:00. Outlet slightly bent.

Action: Straighten CMP and repair displaced joint.

Time: 1 day

Cost: Labour $1,000.00 plus Mat'l $500.00 = $1,500.00

Outfall: AS-12 Galsworthy Pl. 450 mm

Condition: CMP bent inwards.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: AS-15 Paradise Bay 600 mm

Condition: CMP bent at top and side, outlet extends from bank.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: AS-16.5 Orchard Park 600 mm

Condition: CMP slightly bent, outlet extends from bank.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: AS-19 Carroll Rd. 1800 mm

Condition: CMP bent

Action: Assume CMP can be straightened or trimmed.

Time:

Cost: $1,000.00

Outfall: AS-24 Fairmont 2500 mm

Condition: Small piece of CMP missing at outlet

Action: Replace missing CMP, assume 3 lineal m has to be repaired.

Time: 1 day

Cost: \$3,000.00 labour plus \$3,000 material = \$6,000.00

Outfall: AS-60 Chataway Blvd. 900 mm

Condition: 250 mm wide piece of CMP missing at outlet

Action: Replace missing CMP

Time: 1/2 to 1 day

Cost: \$1,000.00 labour plus \$500.00 material = \$1,500.00

Outfall: AS-63 Riverbend Cres. 2250 mm

Condition: Upstream side of CMP bent.

Action: Trim and remove damaged portion of CMP

Time: 1 day

Cost: \$1,000.00

Outfall: AS-67A Route 90 Bridge 450 mm

Condition: Top of CMP bent, opening reduced 10-20%.

Action: assume CMP can be straightened

Time: 1 to 2 hr.

Cost: \$1,000.00

Outfall: AS-69 Tylehurst St. 2250 mm

Condition: Protective railing around outlet structure damaged.

Action: Replace 2 sections of railing

Time: 1/2 to 1 day

Cost: $1,000.00 labour plus $1,000.00 material = $2,000.00

Outfall: AS-76 Ash St. FPS 2100 mm

Condition: Upstream side of CMP bent inwards.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: RR-10 Radcliffe 1200 mm

Condition: Minor denting from 9:00 to 12:00

Action:

Time:

Cost:

note: no hydraulic restriction
re-inspect in 5 years

Outfall: RR-15 Rivergate Dr. 1350 mm

Condition: Minor damage 3:00 to 4:00

Action: Assume CMP can be straightened

Time: 1 hr.

Cost: $1,000.00

Outfall: RR-38 Cockburn St. FPS 1500 mm

Condition: CMP slightly bent

Action: Assume CMP can be straightened.

Time: 1 hr.

Cost: $1,000.00

Outfall: RR-51 Marion St. FPD 1600 mm

Condition: Slightly bent btw. 9:00 and 3:00

Action:

note: no hydraulic restriction
re-inspect in 5 years

Time:

Cost:

Outfall: RR-52 Marion St. 2 1800 mm

Condition: 300 mm wide piece of CMP folded over.

Action: Straighten or remove damaged portion

Time:

Cost: $1,000.00

Outfall: RR-54 Rue Despins

Condition: Top of CMP dented

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: RR-55 Rue Despins FPD 1200 mm

Condition: Upstream side of CMP bent.

Action: Straighten or remove bent portion

Time:

Cost: $1,000.00

Outfall: RR-90 Linden Ave. 1800 mm

Condition: Concrete in poor condition.

Action: Remove damaged conc. to good sound concrete. Replace demolished concrete.

Time: 4 to 5 days

Cost: $2,000.00 labour plus $2,000 mat'l = $4,000.00
(assumes $50/hr. labour)

Outfall: RR-2 Lemay Ave. 900 mm

Condition: CMP dented btw. 6:00 and 2:00.

Action: straighten CMP

Time: 1-2 hr.

Cost: $1,000.00

Outfall: RR-35 Wildwood Golf Course 900 mm

Condition: Small dent at top of CMP.

Action:

note: no hydraulic restriction re-inspect in 5 years

Time:

Cost:

Outfall: RR-41 Churchill Dr. Underpass 800 mm

Condition: Small dents in CMP

Action:

Time:

note: no hydraulic restriction
re-inspect in 5 years

Cost:

Outfall: RR-62 McDermont Ave.

Condition: Tapered end of CMP slightly bent upstream side.

Action: straighten CMP

Time: 1 hr.

Cost: $1,000.00

Outfall: LS-2 Rue Des Trappistes 450 mm

Condition: Top of CMP slightly bent.

Action:

Time:

note: no hydraulic restriction
re-inspect in 5 years

Cost:

Outfall: FL-2 Kildare at Floodway 3000 mm

Condition: Guard rail around outlet bent.

Action: replace damaged guard rail

Time: 1 day

Cost: $1,000.00 labour plus $2,500 mat'l = $3,500.00

Outfall: SE-37 Fermor Ave. 600 mm

Condition: CMP slightly bent.

Action: Straighten or trim damaged portion.

Time:

Cost: $1,000.00

Outfall: ST-1 Old Mill Rd. 400 mm

Condition: 40 mm dent upstream side of CMP

Action:

Time:

note: no hydraulic restriction re-inspect in 5 years

Cost:

Outfall: ST-22 Crestview Park Dr. 750 mm

Condition: Small dents in CMP

Action:

Time:

note: no hydraulic restriction re-inspect in 5 years

Cost:

Outfall: OM-2 Clifton St. Overflow

Condition: Chainlink fence on wingwall damaged.

Action: Repair damaged fence

Time: 1/2 to 1 day

Cost: $1,000.00 labour plus $500.00 mat'l = $1,500.00

Outfall: BU-2 Henderson Hwy. 2 1200 mm

Condition: CMP slightly bent.

Action:

Time:

note: no hydraulic restriction re-inspect in 5 years

Cost:

Outfall: BU-6.1 Delbrook Cres. 2 600 mm

Condition: Top of CMP bent.

Action: Straighten CMP

Time: 1 hr.

Cost: $1,000.00

APPENDIX H
Memorandum

APPENDIX H

MEMORANDUM
Outfall Inspection Program - Economic Analysis of Rehabilitation Alternatives at Unstable Banks

MEMORANDUM

TO: Roy Houston

FROM: Dave MacMillan

DATE: December 5, 1997

RE: Outfall Inspection Program
Economic Analysis of Rehabilitation Alternatives at Unstable Banks

PROJECT NO. 97-107-17

1.0 BACKGROUND

In response to your request, a proposed method to evaluate rehabilitation alternatives for outfall replacements at unstable banks is outlined below for the Steering Committee's review and consideration.

Based upon the assessment to date, an evaluation method is required for those conditions where an outfall needs to be replaced on an unstable bank. Ultimately, the requirement to spend significant expenditures associated with bank stabilization will depend upon the consequences of a bank failure. Where there is no additional consequence, other than the loss of pipe, the decision will tend to favour accepting the risk of bank failure. Where the bank failure consequences are significant, such as a loss of a flood pump station (FPS), impacts on other infrastructure (buried services, roads etc.), then the risk of the additional damages also needs to be considered. In the extreme, a bank failure could lead to an outfall blockage and subsequent upstream flood damages.

Although the total assessment of bank failure consequences can be complex, this methodology is presented to assist the decision making process in those instances where the consequences are limited to the pipe and/or an outfall structure. The methodology, with some effort, could be extended to a more general evaluation of the economics associated with bank stabilization. It is, however, not the intention of this memorandum to explore the level of detail required to consider all of the impacts and consequences of a bank failure. In all cases the assessment should be on a site specific basis and where other bank failure consequences are possible, the results should be interpreted with some caution.

2.0 ASSESSMENT METHODOLOGY

The two scenarios were considered and the evaluation methodology is outlined below.

1. ***Consequence Limited to Loss of the Outfall*** - This evaluation considers the outfall to be replaced on an unstable bank where the consequence of a bank failure is limited to the pipe rupturing. It is assumed that there are no further consequences of the bank failure, such as upstream flooding as a result of a pipe rupture. For this condition, the estimated cost of the bank stabilization is significant in comparison to the loss of the rehabilitation cost of the pipe.

In this example, the decision to proceed with bank stabilization or not depends upon:

- cost of the bank stabilization
- life expectancy of the bank stabilization
- the frequency of which the bank is expected to fail, and
- the cost of the pipe rehabilitation.

The basis for deciding whether or not to stabilize the bank under these conditions is illustrated on Tables 1 and 2 for pipe rehabilitation costs of $30,000 and $150,000.

Based upon these results, it is apparent that for the pipe rehabilitation of less then $150,000 it is more economic to continue to replace the pipe as opposed to stabilize the bank.

2. ***Consequences include Loss of a Flood Pump Station*** - This example considers an outfall to be replaced on a bank where the consequences of a bank failure affects structures, or other infrastructure facilities at the top of the bank. For example, with a flood pump station at the top of the bank, the risk and magnitude of the potential damage to the facility would have to be considered.

   In this case, the decision to proceed with the bank stabilization depends upon:

   - cost of the bank stabilization
   - life expectancy of the bank stabilization
   - the frequency of which the bank is expected to fail
   - the cost of the pipe rehabilitation, and
   - consequences, in terms of damage to the FPS and potential district flooding if the FPS is out of service during a significant spring event where the pumps are required.

   As illustrated in Table 3, 4 and 5, it would be economically advantageous to stabilize the bank if there is a realistic probability of bank failure (ie. greater than 1/300, p= 0.003).

   For an unstable the probability of failure is likely in the order of 1/5, p = 0.2 to 1/20, p = 0.05.

3.0 DATA REQUIRED

To implement the methodology, an assessment of the probability and damages associated with a bank failure would be required on a case by case basis. As well, cost estimates for pipe rehabilitation and bank stabilization would be necessary.

Variables that may be considered would include:

- cost of works (both repair & stabilization)
- actual risk of failures dependent on soil/geometry/precipitation/flood condition
- structure type/location/foundation type
- movement may damage but not block pipe
- small Ø pipes will be more susceptible to blockage
- assessment may have to include costs associated with potential surface flooding which could damage roads, flood basements or surcharge bank failures
- value of land, potentially lost due to bank failure

Table 1

Present Value Cost Comparison Example (1)
Pipe Replacement at Frequency of Bank Failure vs Bank Stabilization

Assumptions		Economic Paramters	
Pipe rehabilitation cost	$30,000	interest rate	8 percent
Bank stabilization cost	$300,000	escalation rate	3 percent
Frequency of bank failure (yrs)	10	net discount rate	5 percent
Life Span of Bank Stabilization (yrs)	50		

Present Value Cost Comparison

Present Value of Bank Stabilization	$300,000	(cost of bank stabilization)
Present Value of Pipe Repairs	$70,041	(cost of pipe repair at frequency of bank failure)

On the basis of a cost comparison

<u>Bank Stabilization is not Justified</u>

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

Table 2

Present Value Cost Comparison Example (1)
Pipe Replacement at Frequency of Bank Failure vs Bank Stabilization

Assumptions		Economic Paramters	
Pipe rehabilitation cost	$\boxed{\$150,000}$	interest rate	8 percent
Bank stabilization cost	$300,000	escalation rate	3 percent
Frequency of bank failure (yrs)	10	net discount rate	5 percent
Life Span of Bank Stabilization (yrs)	50		

Present Value Cost Comparison

Present Value of Bank Stabilization	$300,000	(cost of bank stabilization)
Present Value of Pipe Repairs	$350,204	(cost of pipe repair at frequency of bank failure)

On the basis of a cost comparison

<u>Bank Stabilization is Justified</u>

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

Table 3

Present Value Cost Comparison Example (1)
Risk Assessment of Bank Stabilization Requiremnt

Assumptions

A	Risk of Bank Failure (Probability of failure)	$\boxed{0.1}$
B	Risk of Flooding Following Loss of FPS (prob of rainstorm)	0.1
C	Probabiltiy of Combined Event (A * B)	0.01
	Consequcne of failure (potential damages)	
D	-loss of Flood Pump Station	$3,000,000
E	- flood damges due to event C	$5,000,000
	Annual Risk of Damages	
F	- loss of FPS (A * D)	$300,000
G	- flood damages (C * E)	$50,000
H	- total annual damages (F + G)	$350,000

Economic Parameters

interest rate	8	percent
escalation rate	3	percent
net discount rate	5	percent
economic life	50	yrs

I	Cost of Bank Staiblization	$300,000
J	Annual Cost of Bank Stabilzation (50yr life @ cost I)	$16,433
K	Annual Benfits of Bank Stablization (avoided damages - H)	$350,000

Benefit Cost Ratio (Annual Damages Avoided / Annual Costs)
K / J **21.3**

Bank Stabilzation is Justified

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

Table 4

Present Value Cost Comparison Example (1)
Risk Assessment of Bank Stabilization Requiremnt

Assumptions

A	Risk of Bank Failure (Probability of failure)	$\boxed{0.01}$
B	Risk of Flooding Following Loss of FPS (prob of rainstorm)	0.1
C	Probabiltiy of Combined Event (A * B)	0.001
	Consequcne of failure (potential damages)	
D	-loss of Flood Pump Station	$3,000,000
E	- flood damges due to event C	$5,000,000
	Annual Risk of Damages	
F	- loss of FPS (A * D)	$30,000
G	- flood damages (C * E)	$5,000
H	- total annual damages (F + G)	$35,000

Economic Parameters

interest rate	8	percent
escalation rate	3	percent
net discount rate	5	percent
economic life	50	yrs

I	Cost of Bank Staiblization	$300,000
J	Annual Cost of Bank Stabilzation (50yr life @ cost I)	$16,433
K	Annual Benfits of Bank Stablization (avoided damages - H)	$35,000
	Benefit Cost Ratio (Annual Damages Avoided / Annual Costs) K / J	**2.1**

Bank Stabilzation is Justified

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

Table 5

Present Value Cost Comparison Example (1)
Risk Assessment of Bank Stabilization Requiremnt

Assumptions

A	Risk of Bank Failure (Probability of failure)	$\boxed{0.003}$
B	Risk of Flooding Following Loss of FPS (prob of rainstorm)	0.1
C	Probabiltiy of Combined Event (A * B)	0.0003
	Consequcne of failure (potential damages)	
D	-loss of Flood Pump Station	$3,000,000
E	- flood damges due to event C	$5,000,000
	Annual Risk of Damages	
F	- loss of FPS (A * D)	$9,000
G	- flood damages (C * E)	$1,500
H	- total annual damages (F + G)	$10,500

Economic Parameters

interest rate	8	percent
escalation rate	3	percent
net discount rate	5	percent
economic life	50	yrs

I	Cost of Bank Staiblization	$300,000
J	Annual Cost of Bank Stabilzation (50yr life @ cost I)	$16,433
K	Annual Benfits of Bank Stablization (avoided damages - H)	$10,500

Benefit Cost Ratio (Annual Damages Avoided / Annual Costs)

K / J **0.6**

Bank Stabilzation is not Justified

Note: (1) This example presents a simplified approach to illustrate the proposed evaluation methodolgy, specific conditions must be evaluated for each site.

APPENDIX I
Suggested Outfall Inspections

APPENDIX I

SUGGESTED OUTFALL INSPECTIONS FOR YEAR 1 AND 2

Suggested Outfall Inspections Year 1 (1999)

Outfall ID	Outfall Name	Reason for Inspection
ST-9	Amarynth Cres.	Overall Rating of 4 (96-97)
AS-77	Ash St.	Outfall not inspected (96-97)
AS-32.1	Assiniboine Cres.	Outfall not inspected <= 300 mm dia.
AS-79	Aubrey St.	Outfall not inspected (96-97)
RR-45	Baltimore St. FPS	Overall Rating of 4 (96-97)
RR-21.1	Bishop Grandin Bvld 4	Overall Rating of 4 (96-97)
RR-21.1	Bishop Grandin Bvld 4	Outfall not inspected (96-97)
BU-7	Bonner Ave. 1	Overall Rating of 4 (96-97)
BU-7	Bonner Ave. 1	Outfall not inspected (96-97)
BU-8	Bonner Ave. 2	Outfall not inspected (96-97)
AS-85	Canora St.	Outfall not inspected (96-97)
AS-21	Carroll Rd. 2	Outfall not inspected <= 300 mm dia.
AS-32.4	Charleswood Bridge Drain - North 1	Outfall not inspected <= 300 mm dia.
AS-32.2	Charleswood Bridge Drain - South	Outfall not inspected <= 300 mm dia.
AS-32.3	Charleswood Bridge Drain - South 2	Outfall not inspected <= 300 mm dia.
AS-32.5	Charleswood Bridge Drain - South 3	Outfall not inspected <= 300 mm dia.
AS-60	Chataway Blvd.	Overall Rating of 4 (96-97)
SE-41	Clayton Dr.	Overall Rating of 4 (96-97)
AS-75	Clifton St.	Overall Rating of 4 (96-97)
OM-2	Clifton St. Overflow	Outfall not inspected (96-97)
AS-86	Cornish Ave FPS	Overall Rating of 4 (96-97)
AS-88	Cornish St. 2	Overall Rating of 4 (96-97)
RR-26	Crane Ave.	Overall Rating of 4 (96-97)
RR-27	Crane Ave. Outfall	Overall Rating of 4 (96-97)
ST-21	Crestview Park Dr. (retention pond drainage)	Overall Rating of 4 (96-97)
RR-20	Darcy Dr.	Overall Rating of 4 (96-97)
AS-53	Deer Lodge Pl.	Outfall not inspected <= 300 mm dia.
BU-6.1	Delbrook Cres. 2	Overall Rating of 4 (96-97)
BU-6.1	Delbrook Cres. 2	Outfall not inspected (96-97)
RR-47	Eccles St.	Outfall not inspected (96-97)
AS-78	Elm St.	Overall Rating of 4 (96-97)
RR-81	Elmwood Park	Overall Rating of 4 (96-97)
OM-15	Empress St. 10	Outfall not inspected <= 300 mm dia.
OM-16	Empress St. 11	Outfall not inspected <= 300 mm dia.
OM-17	Empress St. 12	Outfall not inspected <= 300 mm dia.
OM-18	Empress St. 13	Outfall not inspected <= 300 mm dia.
OM-19	Empress St. 14	Outfall not inspected <= 300 mm dia.
OM-21	Empress St. 16	Outfall not inspected <= 300 mm dia.
OM-22	Empress St. 17	Outfall not inspected <= 300 mm dia.
OM-23	Empress St. 18	Outfall not inspected <= 300 mm dia.
OM-24	Empress St. 19	Outfall not inspected <= 300 mm dia.
OM-12	Empress St. 7	Outfall not inspected <= 300 mm dia.
OM-13	Empress St. 8	Outfall not inspected <= 300 mm dia.
OM-14	Empress St. 9	Outfall not inspected <= 300 mm dia.
AS-24	Fairmont	Outfall not inspected (96-97)
SE-37	Fermor Ave.	Overall Rating of 4 (96-97)
AS-59	Ferry Rd.	Outfall not inspected (96-97)
AS-92	Fort Rouge Park	Overall Rating of 4 (96-97)
AS-92	Fort Rouge Park	Outfall not inspected (96-97)

Suggested Outfall Inspections Year 1 (1999)

Outfall ID	Outfall Name	Reason for Inspection
SE-29	Gareau St.	Overall Rating of 4 (96-97)
BU-16	Gateway Rd.	Outfall not inspected (96-97)
RR-6	Grandmont Blvd.	Overall Rating of 4 (96-97)
ST-18	Hamilton Ave.	Overall Rating of 4 (96-97)
ST-18.1	Hamilton Ave. 2	Overall Rating of 4 (96-97)
RR-98	Hawthorne Ave.	Overall Rating of 4 (96-97)
BU-18	Jim Smith Dr.	Outfall not inspected (96-97)
RR-12	Kings Dr.	Overall Rating of 4 (96-97)
RR-40	Kingston Row Underpass	Overall Rating of 4 (96-97)
RR-61	Lombard Ave.	Outfall not inspected (96-97)
BU-23	Mallows Way	Outfall not inspected (96-97)
AS-86B	Maryland St.	Outfall not inspected (96-97)
AS-99	Mayfair Ave.	Overall Rating of 4 (96-97)
AS-99	Mayfair Ave.	Outfall not inspected (96-97)
BU-12	McIvor Ave.	Overall Rating of 4 (96-97)
AS-32	McQuaker Dr.	Outfall not inspected (96-97)
RR-46	Metcalfe Pl.	Overall Rating of 4 (96-97)
SE-1	Mission FPS	Overall Rating of 4 (96-97)
AS-39	Mount Royal Cres. 1	Outfall not inspected <= 300 mm dia.
AS-31	Oakdale Dr.	Outfall not inspected (96-97)
AS-33	Olive St.	Overall Rating of 4 (96-97)
AS-34	Olive St. 2	Outfall not inspected (96-97)
AS-62	Parkside Dr.	Overall Rating of 4 (96-97)
RR-11	Radcliffe	Overall Rating of 4 (96-97)
RR-11	Radcliffe	Outfall not inspected (96-97)
RR-10	Radcliffe 1	Overall Rating of 4 (96-97)
OM-1	Raglan Rd.	Overall Rating of 4 (96-97)
BU-17	Regatta Rd.	Outfall not inspected <= 300 mm dia.
BU-19	Regatta Rd. 2	Outfall not inspected <= 300 mm dia.
AS-72	Renfrew St.	Outfall not inspected (96-97)
RR-18	River Pointe Pl.	Overall Rating of 4 (96-97)
AS-63	Riverbend Cres.	Overall Rating of 4 (96-97)
RR-23	Riviera Cres. Outfall	Overall Rating of 4 (96-97)
BU-4	Rothesay St. N.	Outfall not inspected (96-97)
BU-5	Rothesay St. S.	Outfall not inspected (96-97)
AS-67A	Route 90 Bridge	Overall Rating of 4 (96-97)
AS-65A	Route 90 Overpass	Outfall not inspected <= 300 mm dia.
SE-53.1	Royalwood Subdivision	Overall Rating of 4 (96-97)
AS-82	Ruby St. 2	Outfall not inspected (96-97)
SE-34	Rue Archibald St.	Overall Rating of 4 (96-97)
SE-10	Rue Bourgeault	Overall Rating of 4 (96-97)
LS-1.1	Rue Campeau	Outfall not inspected <= 300 mm dia.
SE-4	Rue Notre Dame W.	Overall Rating of 4 (96-97)
ST-24	Saskatchewan Ave.	Overall Rating of 4 (96-97)
RR-14	SEWPCC Outfall	Outfall not inspected (96-97)
AS-20	Shelmardine Dr.	Outfall not inspected <= 300 mm dia.
ST-19	Silver Ave.	Overall Rating of 4 (96-97)
AS-89	Spence St.	Overall Rating of 4 (96-97)
AS-89	Spence St.	Outfall not inspected (96-97)

Suggested Outfall Inspections Year 1 (1999)

Outfall ID	Outfall Name	Reason for Inspection
RR-16	St. Mary's Rd. 2	Overall Rating of 4 (96-97)
RR-106	Summerview Lane	Outfall not inspected (96-97)
BU-20	Sun Valley Dr.	Outfall not inspected (96-97)
BU-21	Sunny Hills Rd.	Outfall not inspected (96-97)
AS-97	The Forks E. of C.N.R. Bridge	Outfall not inspected (96-97)
BU-10	Uxbridge Rd. N.	Overall Rating of 4 (96-97)
BU-11	Uxbridge Rd. S.	Overall Rating of 4 (96-97)
ST-15	Valleyview Dr. 1	Overall Rating of 4 (96-97)
ST-16	Valleyview Dr. 2	Overall Rating of 4 (96-97)
OM-11	Velodrome 2	Outfall not inspected <= 300 mm dia.
OM-10	Velodrome Meter Pit	Outfall not inspected <= 300 mm dia.
RR-29	Victoria Cres. 2	Overall Rating of 4 (96-97)
RR-29	Victoria Cres. 2	Outfall not inspected (96-97)
ST-20	Voyageur	Overall Rating of 4 (96-97)
RR-56	Water Ave.	Outfall not inspected (96-97)
RR-56.1	Water Ave. 2	Outfall not inspected (96-97)
AS-67	Wellington Cres. at CNR Bridge	Outfall not inspected (96-97)
AS-1	WEWPCC Outfall	Outfall not inspected (96-97)
AS-36A	Wexford Lift Station	Outfall not inspected <= 300 mm dia.
BU-22	Wpg. Hydro Transmission Line	Outfall not inspected (96-97)

Suggested Outfall Inspections Year 2 (2000)

Outfall ID	Outfall Name	Reason for Inspection
RR-76.5	Aberdeen Ave.	Outfall not inspected <= 300 mm dia.
ST-13	Alcott	Outfall not inspected (96-97)
SE-35	Avondale Rd.	Outfall not inspected (96-97)
SE-49	Beliveau Rd.	Outfall not inspected (96-97)
SE-42	Berrydale Ave.	Outfall not inspected (96-97)
SE-52	Bishop Grandin Bvld.	Outfall not inspected (96-97)
SE-14	Cherrier St.	Outfall not inspected <= 300 mm dia.
RR-47.5	Churchill High School	Outfall not inspected (96-97)
SE-41	Clayton Dr.	Outfall not inspected (96-97)
SE-57	Compark	Outfall not inspected (96-97)
SE-24.1	Deniset St. 1	Outfall not inspected <= 300 mm dia.
SE-26	Deniset St. 2	Outfall not inspected <= 300 mm dia.
SE-15	Doucet St.	Outfall not inspected <= 300 mm dia.
SE-25	Dubuc St.	Outfall not inspected <= 300 mm dia.
SE-19	Dugald Ditch S. 1	Outfall not inspected <= 300 mm dia.
SE-20	Dugald Ditch S. 2	Outfall not inspected <= 300 mm dia.
RR-47.1	Eccles St. 2	Outfall not inspected (96-97)
RR-81	Elmwood Park	Outfall not inspected (96-97)
OM-5	Empress St. 2	Outfall not inspected <= 300 mm dia.
OM-25	Empress St. 20	Outfall not inspected <= 300 mm dia.
OM-26	Empress St. 21	Outfall not inspected <= 300 mm dia.
OM-6	Empress St. 3	Outfall not inspected <= 300 mm dia.
OM-7	Empress St. 4	Outfall not inspected <= 300 mm dia.
OM-8	Empress St. 5	Outfall not inspected <= 300 mm dia.
OM-9	Empress St. 6	Outfall not inspected <= 300 mm dia.
RR-32.5	Fermor Ave	Outfall not inspected (96-97)
SE-40	Fernwood Ave.	Outfall not inspected (96-97)
RR-64	Galt Ave. FPS	Outfall not inspected (96-97)
SE-13	Giroux St.	Outfall not inspected <= 300 mm dia.
ST-7.1	Greenway Cres. 2	Outfall not inspected (96-97)
ST-18.1	Hamilton Ave. 2	Outfall not inspected (96-97)
SE-45	Hindley Ave.	Outfall not inspected (96-97)
RR-85	Inkster Blvd.	Outfall not inspected (96-97)
RR-34.1	Kingston Row	Outfall not inspected <= 300 mm dia.
SE-51	Lavalee Rd.	Outfall not inspected (96-97)
ST-10	Lonsdale Dr. 2	Outfall not inspected <= 300 mm dia.
SE-16	Marion St.	Outfall not inspected <= 300 mm dia.
RR-62	McDermot Ave.	Outfall not inspected (96-97)
SE-50	N. of Beaverhill Bvld.	Outfall not inspected (96-97)
SE-55	N. of John Bruce Rd.	Outfall not inspected (96-97)
ST-14	Ness Ave.	Outfall not inspected (96-97)
RR-99	NEWPCC Outfall Kildonan Golf Course	Outfall not inspected (96-97)
ST-2	Oakdean Cres.	Outfall not inspected <= 300 mm dia.
ST-1	Old Mill Rd.	Outfall not inspected (96-97)
RR-47.4	Open Culvert from Football Field	Outfall not inspected <= 300 mm dia.
SE-6	Provencher Bvld.	Outfall not inspected <= 300 mm dia.
SE-7	Provencher Bvld. 2	Outfall not inspected <= 300 mm dia.
SE-9	Provencher Bvld. 3	Outfall not inspected <= 300 mm dia.
SE-54	Public Lane E. of Meadowood Dr.	Outfall not inspected (96-97)

Suggested Outfall Inspections Year 2 (2000)

Outfall ID	Outfall Name	Reason for Inspection
SE-53	Richfield Ave.	Outfall not inspected (96-97)
RR-93	Rossmere Cres.	Outfall not inspected (96-97)
SE-53.1	Royalwood Subdivision	Outfall not inspected (96-97)
SE-10	Rue Bourgeault	Outfall not inspected (96-97)
SE-3	Rue Notre Dame E.	Outfall not inspected <= 300 mm dia.
SE-11	Rue Plinguet	Outfall not inspected <= 300 mm dia.
SE-44	Sadler Ave.	Outfall not inspected (96-97)
SE-58	Southglen	Outfall not inspected (96-97)
SE-58.1	St. Annes Rd.	Outfall not inspected (96-97)
SE-22	St. Catherine St. 2	Outfall not inspected <= 300 mm dia.
RR-16	St. Mary's Rd. 2	Outfall not inspected (96-97)
RR-39.7	St. Vital Bridge	Outfall not inspected (96-97)
ST-4	Sturgeon Rd. (north)	Outfall not inspected (96-97)
ST-5	Sturgeon Rd. (south)	Outfall not inspected (96-97)
SE-23	Tremblay St.	Outfall not inspected <= 300 mm dia.
SE-48	Willowlake Cres.	Outfall not inspected (96-97)
SE-56	Woodydell	Outfall not inspected (96-97)
SE-46	Worthington Ave.	Outfall not inspected (96-97)