JOINT REPAIR OF REINFORCED CONCRETE
SUBMERGED CULVERT S–1 AND S–2
WINDSOR ESSEX PKWY
WINDSOR, ON, CANADA

GENERAL NOTES:

1. THIS REPAIR DESIGN ASSUMES NO STRUCTURAL DEFICIENCIES WITH THE PIPE AND DOES NOT ADDRESS SOIL MIGRATION THROUGH THE LEAKING JOINTS AND POSSIBLE LOSS OF BACKFILL SUPPORT, IF IT EXISTS.
2. CONTRACTOR IS TO NOTIFY THE ENGINEER IF THE REPAIR JOINTS ARE VERTICALLY OFFSET OR THE JOINT GAP EXCEEDS A MAXIMUM OF 64 MM (2.5 IN.) FOR THE CULVERT S–1 (2400 MM DIAMETER RCP) OR 38 MM (1.5 IN.) FOR THE CULVERT S–2 (3000 MM DIAMETER RCP).
3. CONTRACTOR IS TO NOTIFY THE ENGINEER OF ANY SETTLEMENT OR CRACKING OF THE CULVERT.
4. THE JOINT REPAIR IS DESIGNED FOR A MAXIMUM NET EXTERNAL GROUNDWATER PRESSURE OF 10 PSI (7.0 M (23 FT) WATER COLUMN).
5. CONSTRUCTION AND MAINTENANCE REQUIRING THE SUBMERGED CULVERTS BE DEWATERED SHOULD BE RESTRICTED TO PERIODS WHERE THERE IS A LOW GROUNDWATER CONDITION (LESS THAN 7 M (23 FT) ABOVE THE INVERT OF THE CULVERTS).

LIST OF ABBREVIATIONS:

HF – HIGH FLOW
LF – LOW FLOW
RHF – RAISED HIGH FLOW
RCP – REINFORCED CONCRETE PIPE
EPDM – ETHYLENE PROPYLENE DIENE MONOMER

TABLE OF CONTENTS:

Seal:

Aaron J. Roffel
Ontario License No. 100142909

REV	DESCRIPTION	BY	DATE
1	PER PARKWAY INFRASTRUCTURE CONSTRUCTORS REVIEW	AJR	06/18/2014
0	FOR REVIEW	AJR	06/11/2014

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Project: JOINT REPAIR OF REINF. CONCRETE, SUBMERGED CULVERT S–1 AND S–2, WINDSOR ESSEX PKWY, WINDSOR, ON, CANADA

Drawing No.: R–00

Title: COVER SHEET

Scale: AS NOTED

Drawn:	Checked:	Approved:	Project No.:	Date:
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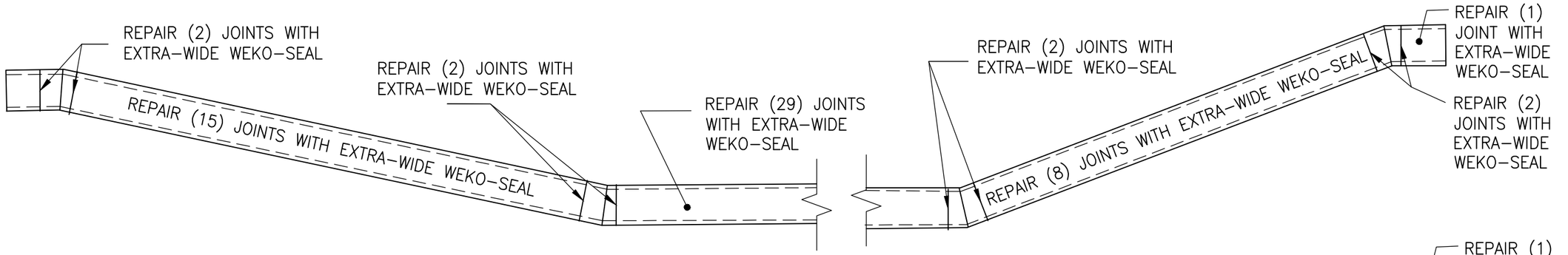
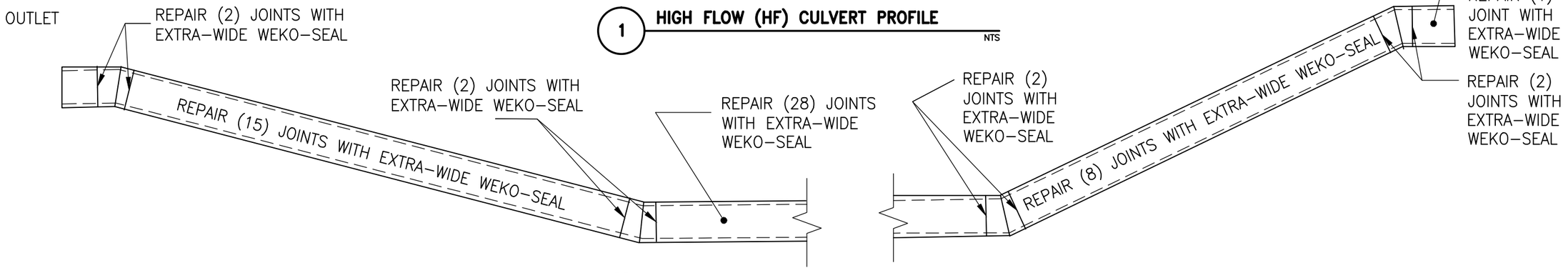


1 HIGH FLOW (HF) CULVERT PROFILE
NTS



2 RAISED HIGH FLOW (RHF) CULVERT PROFILE
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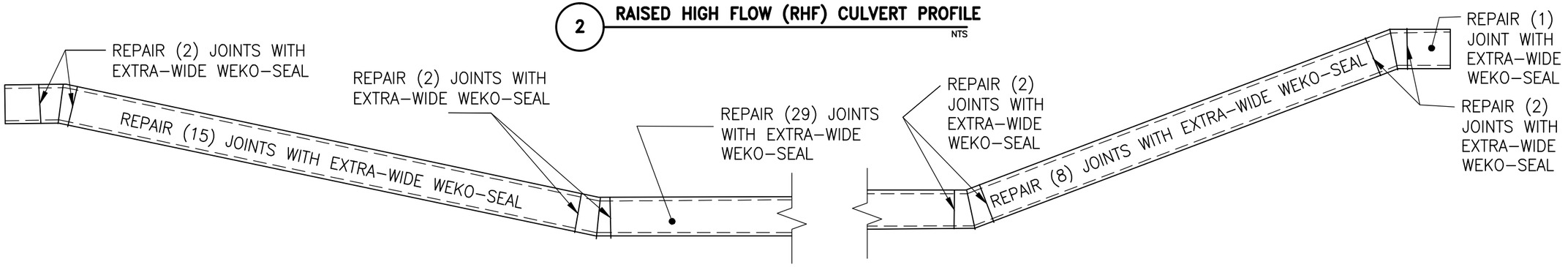

3 LOW FLOW (LF) CULVERT PROFILE
NTS

NOTES: REFER TO R–03 FOR WEKO–SEAL DETAILS AND INSTALLATION PROCEDURES.
QUANTITIES ARE BASED ON CON CAST PIPE DRAWING NOS. S1–2400, REV. 2 AND, S2–3000, REV. 2 AND ARE FOR INFORMATION ONLY; CONTRACTOR TO CONFIRM.

CULVERT	NOMINAL DIAMETER, MM	PRODUCT USED	QTY
HIGH FLOW (HF)	2400	MILLER PIPELINE CORP. EXTRA–WIDE WEKO–SEAL, WITH (3) 51 MM (2 IN.) WIDE BY 6.4 MM (0.25 IN.) THICK TYPE 304 STAINLESS STEEL RETAINING BANDS	61
RAISED HIGH FLOW (RHF)	2400		60
LOW FLOW (LF)	2400		61
TOTAL			182

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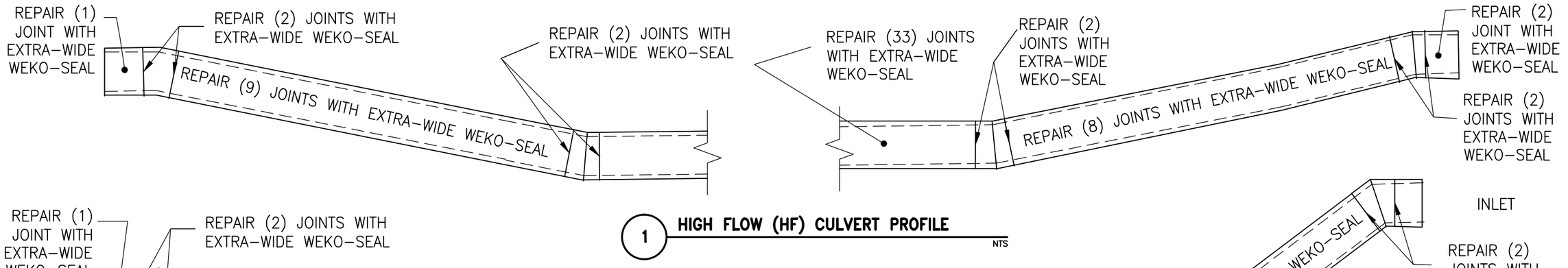
REV	DESCRIPTION	BY	DATE
1	PER PARKWAY INFRASTRUCTURE CONSTRUCTORS REVIEW	AJR	06/18/2014
0	FOR REVIEW	AJR	06/11/2014

Project: JOINT REPAIR OF REINF. CONCRETE, SUBMERGED CULVERT S–1 AND S–2, WINDSOR ESSEX PKWY, WINDSOR, ON, CANADA

Title: LENNON SUBMERGED CULVERT S–1 (2400 MM DIA.)

Drawn:	Checked:	Approved:	Project No.:
ACRG	AJR	RPO	140654.00

Drawing No.: R–01
Scale: AS NOTED
Date: 06/18/14



1 HIGH FLOW (HF) CULVERT PROFILE
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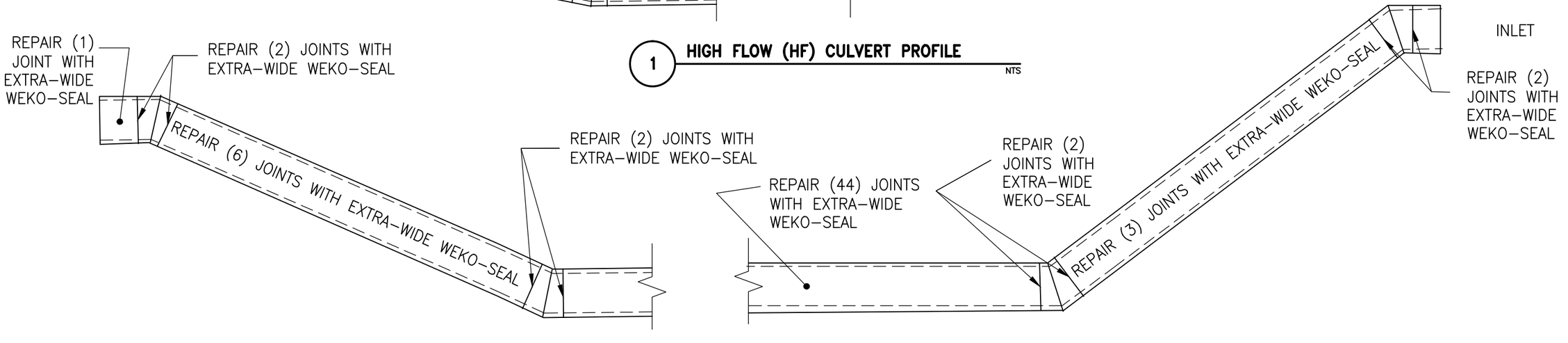

2 RAISED HIGH FLOW (RHF) CULVERT PROFILE
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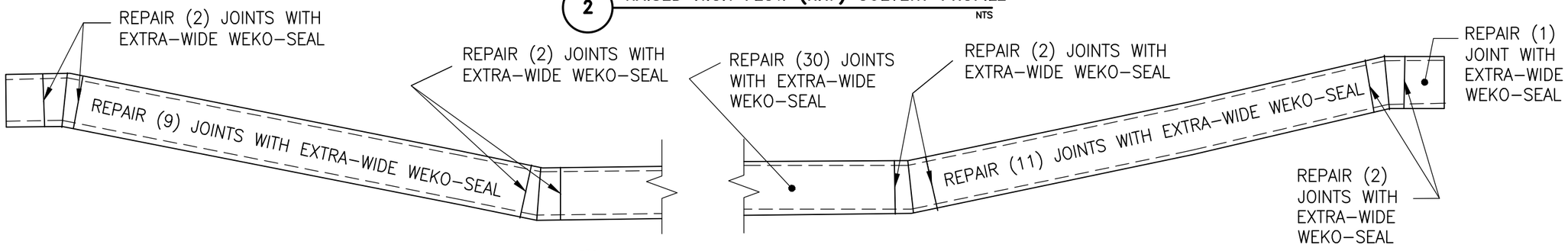

3 LOW FLOW (LF) CULVERT PROFILE
NTS

NOTES: REFER TO R–03 FOR WEKO–SEAL DETAILS AND INSTALLATION PROCEDURES.
QUANTITIES ARE BASED ON CON CAST PIPE DRAWING NOS. S1–2400, REV. 2 AND, S2–3000, REV. 2 AND ARE FOR INFORMATION ONLY; CONTRACTOR TO CONFIRM.

CULVERT	NOMINAL DIAMETER, MM	PRODUCT USED	QTY
HIGH FLOW (HF)	3000	MILLER PIPELINE CORP. EXTRA–WIDE WEKO–SEAL, WITH (3) 51 MM (2 IN.) WIDE BY 6.4 MM (0.25 IN.) THICK TYPE 304 STAINLESS STEEL RETAINING BANDS	61
RAISED HIGH FLOW (RHF)	3000		62
LOW FLOW (LF)	3000		59
TOTAL			182

Seal:

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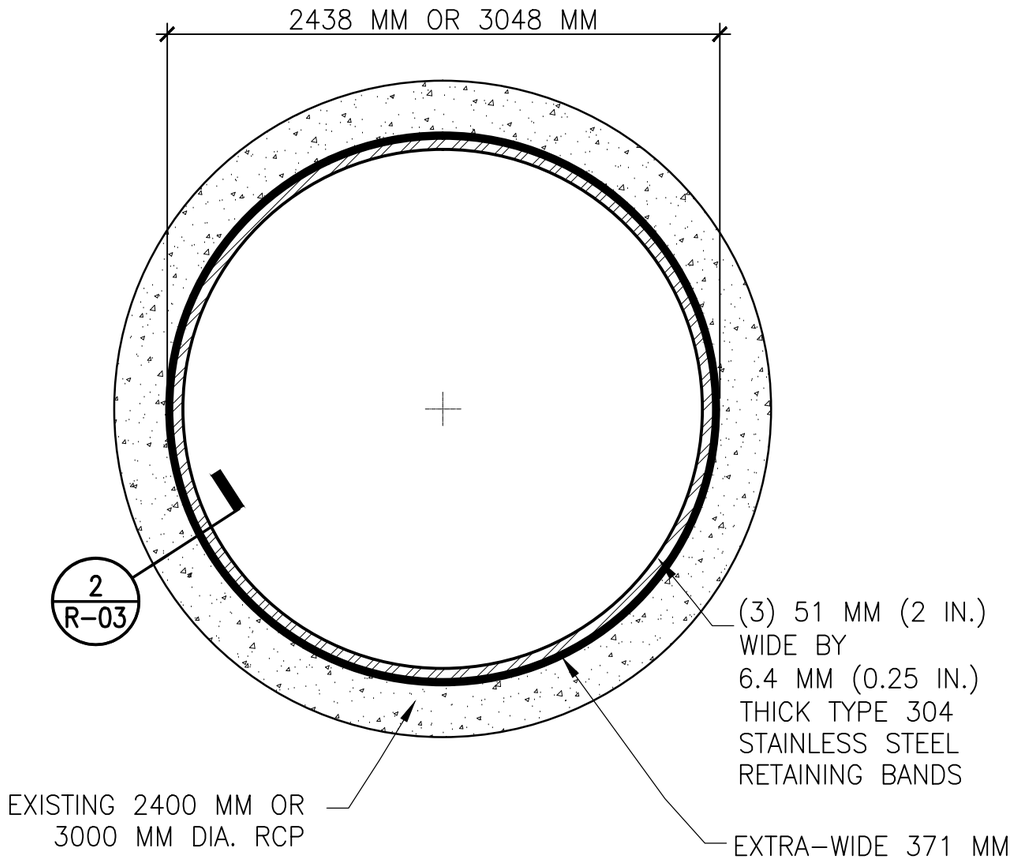
REV	DESCRIPTION	BY	DATE
1	PER PARKWAY INFRASTRUCTURE CONSTRUCTORS REVIEW	AJR	06/18/2014
0	FOR REVIEW	AJR	06/11/2014

Project: JOINT REPAIR OF REINF. CONCRETE, SUBMERGED CULVERT S–1 AND S–2, WINDSOR ESSEX PKWY, WINDSOR, ON, CANADA

Title: CAHILL SUBMERGED CULVERT S–2 (3000 MM DIA.)

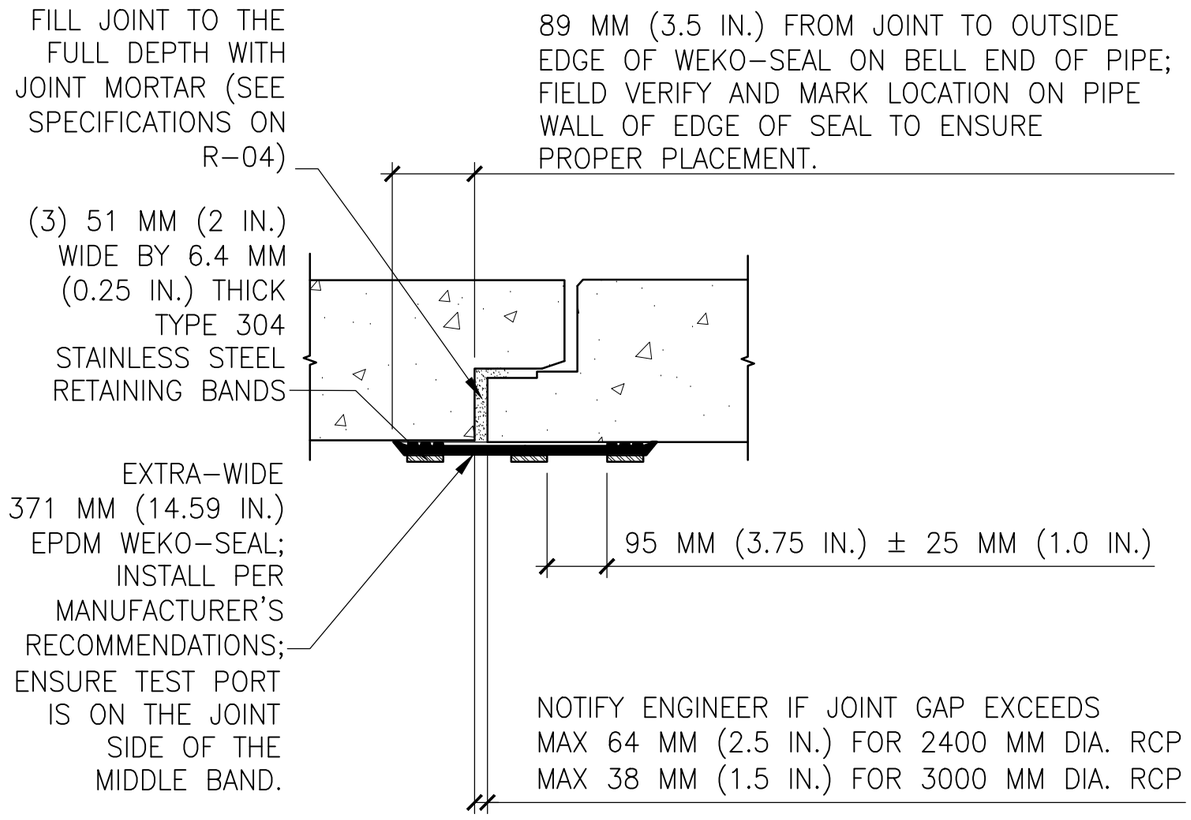
Drawn:	Checked:	Approved:	Project No.:
ACRG	AJR	RPO	140654.00

Drawing No.: R–02
Scale: AS NOTED
Date: 06/18/14



1 DETAIL

NTS



2 SECTION AT JOINT

NTS

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REV	DESCRIPTION	BY	DATE
1	PER PARKWAY INFRASTRUCTURE CONSTRUCTORS REVIEW	AJR	06/18/2014
0	FOR REVIEW	AJR	06/11/2014

Project: JOINT REPAIR OF REINF. CONCRETE, SUBMERGED CULVERT S-1 AND S-2, WINDSOR ESSEX PKWY, WINDSOR, ON, CANADA

Drawing No.: R-03

Title: TYPICAL JOINT REPAIR DETAIL

Scale: AS NOTED

Drawn:	Checked:	Approved:	Project No.:	Date:
ACRG	AJR	RPO	140654.00	06/18/2014

JOINT AND SURFACE PREPARATION

1. REMOVE DIRT, SEDIMENT, AND OTHER DEBRIS FROM THE PIPE WALLS AND JOINT IN AREAS WHERE THE SEALS ARE TO BE INSTALLED. CLEANING SHALL BE PERFORMED AT LEAST 76 MM (3 IN.) BEYOND EITHER SIDE OF PROPOSED SEAL POSITION. CLEAN BY HAND BRUSHING AND SCRAPING, WIRE BRUSH, GRINDER, AND/OR COMPRESSED AIR.
2. FILL JOINTS TO THE FULL DEPTH OF THE GAP WITH JOINT MORTAR AND RENDER FLUSH WITH THE SURROUNDING SURFACE.
   - 2.1. BATCH PROPORTIONS OF THE CEMENT MORTAR SHALL CONSIST OF ONE PART PORTLAND CEMENT TO NOT MORE THAN THREE PARTS OF FINE AGGREGATE, BY WEIGHT. THE MOISTURE CONTENT OF A SAMPLE OF THE MORTAR MIX SHALL BE KEPT AT A MINIMUM, BUT NOT LESS THAN 7% OF THE TOTAL DRY WEIGHT OF THE MIX. CEMENT TYPE SHALL CONFORM TO ASTM C150. THE CEMENT SHOULD NOT INCLUDE CHLORIDES. FINE AGGREGATES SHALL CONSIST OF NATURAL SAND OR SAND OBTAINED BY CRUSHING STONE OR GRAVEL AND SHALL COMPLY WITH ASTM C33. THE WATER-SOLUBLE CONTENT OF THE CHLORIDE-ION CONTENT OF THE MORTAR MIX, EXPRESSED AS A PERCENT OF THE WEIGHT OF CEMENT, SHALL NOT EXCEED 0.06%.
   - 2.2. WET THE REPAIR AREA WITH CLEAN WATER TO ACHIEVE A SATURATED SURFACE DRY (SSD) CONCRETE. FOR NON-FORMED APPLICATIONS, APPLY A SLURRY PROPORTIONED AS 94 LBS OF CEMENT TO NOT MORE THAN 8 GAL OF WATER.
   - 2.3. FOR VERTICAL AND OVERHEAD APPLICATIONS WHERE FORMWORK IS NEEDED, CONSTRUCT FORMS TIGHT AGAINST EXISTING CONCRETE TO PREVENT LOSS OF THE CEMENT MORTAR. FORMWORK MUST ACCOMMODATE THE MASS AND PRESSURE OF THE REPAIR MATERIAL. ADJUST THE FORMWORK TO AVOID AIR POCKETS.
   - 2.4. MIX MORTAR THOROUGHLY WITH MECHANICAL MIXERS, SLOW SPEED DRILLS, OR MORTAR MIXERS, AS NEEDED.
   - 2.5. FOR NON-FORMED APPLICATIONS, APPLY REPAIR MORTAR BY TROWELING OR HAND PACKING TO ACHIEVE A DENSE MORTAR. FOR FORMED VERTICAL AND OVERHEAD APPLICATIONS, PUMP MORTAR INTO THE FORMS. DEPOSIT MORTAR CONTINUOUSLY TO AVOID SEGREGATION. ALL SURPLUS MATERIAL SHALL BE REMOVED FROM THE PIPE.
3. REMOVE ALL SURFACE IMPERFECTIONS RUNNING THROUGH OR PART WAY THROUGH THE SEALING SURFACE BEFORE INSTALLATION OF THE SEALS. ANY JOINT GAPS, LOW AREAS, OR DEEP IMPERFECTIONS MUST BE PROPERLY FILLED WITH JOINT MORTAR AND RENDERED SMOOTH TO SUIT THE PREPARED SURFACE OF THE JOINT AREA. IT MAY BE NECESSARY TO APPLY A THIN LAYER OF QUICK-SETTING CEMENT MORTAR TO THE PREPARATION AREA WHERE THE SEAL WILL BE PLACED TO CONTROL PIPE POROSITY AND IRREGULARITIES TO PROVIDE AN EFFECTIVE LEAK TEST ON THE COMPLETED SEAL.
4. VERIFY THAT THE SEALING SURFACE WITHIN 76 MM (3 IN.) OF AREA WHERE THE SEALS ARE TO BE SEATED IS FREE OF DEBRIS AND SMOOTH.

WEKO-SEAL INSTALLATION

5. MARK THE LOCATION ON PIPE WALL OF EDGE OF SEAL TO ENSURE PROPER PLACEMENT. MAINTAIN 89 MM (3.5 IN.) FROM THE JOINT TO THE OUTSIDE EDGE OF THE WEKO-SEAL ON THE PIPE BELL END. FIELD VERIFY AND MARK THE LOCATION ON THE PIPE WALL AT THE EDGE OF THE SEAL AT A MINIMUM OF FOUR LOCATIONS AROUND THE CIRCUMFERENCE TO ENSURE PROPER PLACEMENT.
6. HAND-APPLY PIPE LUBRICANT USING A BRUSH OVER THE PREPARED AREA. DO NOT ACQUIRE DEBRIS FROM THE SURROUNDING UNPREPARED SURFACES INTO THE LUBRICANT.
7. POSITION THE WEKO-SEAL PARALLEL TO THE JOINT GAP WITH THE PRESSURE TEST VALVE LOCATED AT APPROXIMATELY 3 O'CLOCK OR 9 O'CLOCK POSITION.
8. INSTALL THREE METAL RADIUSED SHIMS UNDERNEATH THE WEDGE AREAS IN THE SEAL GROOVES FOR EACH RETAINING BAND.
9. INSTALL THE UPSTREAM AND DOWNSTREAM STAINLESS STEEL RETAINING BANDS INTO POSITION BY PLACING IN DESIGNATED SEAL GROOVES. SINCE THE RETAINING BANDS ARE THREE-PIECE CONSTRUCTION, A RETAINER CLIP IS TO BE USED TO RESTRAIN BAND MOVEMENT DURING EXPANSION. INSTALL THE MIDDLE RETAINING BAND SUCH THAT THE TEST PORT IS ON THE JOINT SIDE OF THE MIDDLE RETAINING BAND. NOTE THAT THE SEAL DOES NOT HAVE A DESIGNATED POSITIONING GROOVE FOR THE MIDDLE RETAINING BAND.
10. POSITION THE HYDRAULIC EXPANDER DEVICE IN-LINE WITH THE FIRST RETAINING BAND WHILE ENSURING THAT THE RETAINING BAND REMAINS IN POSITION AND DOES NOT MOVE OR BECOME DISLODGED. CARE MUST BE TAKEN TO ENSURE THAT THE EXPANDER IS POSITIONED CORRECTLY ON THE BAND.
11. EXPAND THE STAINLESS STEEL RETAINING BANDS USING THE LARGE HYDRAULIC EXPANDER (ENERPAC RC-104 CYLINDER) TO 5,000-6,000 PSI, HOLDING PRESSURE FOR AT LEAST TWO MINUTES. EXTREME CAUTION SHOULD BE TAKEN TO ENSURE THAT RECOMMENDED EXPANSION PRESSURES ARE NOT EXCEEDED, RESULTING IN PIPE AND/OR SEAL DAMAGE.
12. PLACE A FITTED RADIUSED-LOCKING PIECE (WEDGE) BETWEEN THE EXPOSED GAP OF THE EXPANDED BAND ENDS. SELECT A SIZE OF WEDGE HAVING A SLIGHT INTERFERENCE FIT BETWEEN THE BAND ENDS. THE RADIUS OF THE WEDGE IS EQUAL TO THE RADIUS OF THE PIPE. TAP THE WEDGE (LEADING EDGE FIRST) INTO POSITION, LOCKING IN THE COMPRESSION OF THE SEAL. RELEASE THE PRESSURE FROM THE EXPANDER.
13. REPEAT PROCEDURE (STEPS 9-12) ON THE SECOND RETAINING BAND OF THE SEAL, AND FINALLY THE MIDDLE BAND.
14. PERFORM A SECOND EXPANSION FOR EACH OF THE RETAINING BANDS A MINIMUM OF 30 MINUTES AFTER THE FIRST EXPANSION. EXPAND TO MINIMUM 5,000-6,000 PSI USING THE LARGE HYDRAULIC EXPANDER (ENERPAC RC-104 CYLINDER) AND ENSURE THAT WEDGE IS TIGHT FIT. THIS ALLOWS FOR ANY SEAL RELAXATION THAT MAY OCCUR. IF REQUIRED, REPLACE WEDGE PIECE WITH A LARGER SIZE TO PROVIDE INTERFERENCE FIT.

PRESSURE TEST

15. PERFORM A PRESSURE TEST ON THE SEAL SECTIONS AFTER A MINIMUM OF 30 MINUTES HAS ELAPSED AFTER FINAL FITTING OF THE SEAL TO BE TESTED, IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. THE TESTING PRESSURE SHOULD BE 4-5 PSI.
16. DEPRESSURIZE THE SEAL AND ISOLATE TEST PORT. SEAL THE TEST VALVE WITH A COUNTERSUNK HEX HEAD COMPLETION SCREW USING AN APPROVED THREAD SEALING COMPOUND. REMOVE ALL INSTALLATION HARDWARE, AND PRESSURE GAUGES.

QUALITY CONTROL

17. THE PRODUCT MANUFACTURER SHALL VERIFY THAT EACH SEAL IS INSTALLED PER THE SPECIFICATIONS AND MANUFACTURER'S RECOMMENDATIONS. SUBMIT THE WEKO-SEAL INSTALLATION VERIFICATION FORM TO THE ENGINEER.

Seal:

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Project: JOINT REPAIR OF REINF. CONCRETE, SUBMERGED CULVERT S-1 AND S-2, WINDSOR ESSEX PKWY, WINDSOR, ON, CANADA

Title: JOINT REPAIR SPECIFICATIONS

Drawn:	Checked:	Approved:	Project No.:
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Drawing No.: R-04

Scale: AS NOTED

Date: 06/18/14