



# **ASSESSMENT OF ERROR DUE TO ORIFICE DIAMETER MIS-MEASUREMENT AT HYDES PASTURES**

**A Report for**

**National Grid  
Brick Kiln Street  
HINCKLEY  
Leicestershire  
LE10 0NA**

**Project No: NGR010**

**Report No: 2010/441**

**Date: November 2010**



**This report is issued as part of the contract under which the work has been carried out for the client.**

## **NOTES**

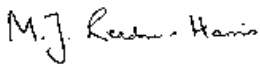
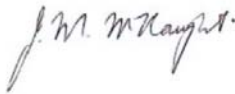
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## Assessment of Error Due to Orifice Diameter Mis-Measurement at Hydes Pastures

A Report for

National Grid  
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LE10 0NA

<b>Prepared by:</b>  	<b>Approved by:</b>  
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for  
Michael Valente  
Managing Director

Date: 9 November 2010

## **EXECUTIVE SUMMARY**

Owing to a mis-measurement of orifice diameters flows have been mis-measured at affected offtakes connected to the National Transmission System. This project has been undertaken to resolve these errors.

At Hydes Pastures a correction factor of 1.002702 should be applied during the period of mis-measurement.

Over the period 06/02/2007 to 15/04/2008 inclusive the flow was 40.81262 mscm and the corrected flow should be 40.92256 mscm.

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## 1 INTRODUCTION

Owing to a mis-measurement of orifice diameters flows have been mis-measured at affected offtakes connected to the National Transmission System. This project has been undertaken to resolve these errors. This report covers the flows through Hydes Pastures in the period of the error. The Joint Office Error Code is WM007.

## 2 ORIFICE DIAMETERS

The calibrations of the orifice plates in question gave the measured diameters shown in Table 1. The diameters at 20 °C have been calculated.

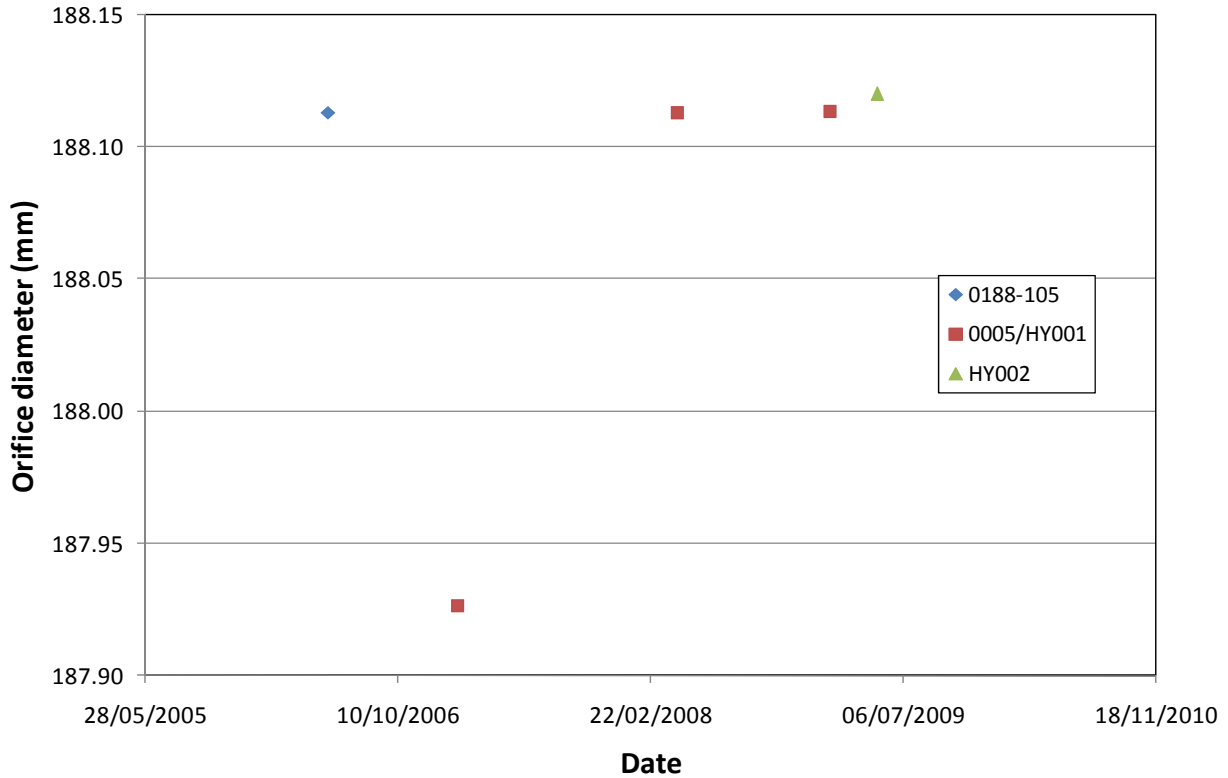
**TABLE 1**  
**ORIFICE DIAMETERS**

Calibration Reference	Plate serial no	Declared certificate date	Orifice bore (mm)	Temperature (°C)	Value at 20 °C
					Orifice bore (mm)
OP60082	0188-105	25/05/2006	188.1130	20	188.1130
OP70023	0005*	06/02/2007	187.9295	21	187.9265
OP80012	HY001*	15/04/2008	188.1130	20	188.1130
OP90006	HY001*	11/02/2009	188.115	20.5	188.1135
OP90012	HY002	15/05/2009	188.1215	20.4	188.1203

NOTE: The fact that 0005 and HY001 are in fact the same plate can be seen from the photograph of part of the orifice plate in Appendix A.

Figure 1 shows the data from Table 1 for the orifice bores at 20°C. This figure shows that the measured diameter for one plate increased. The deduction from this graph is that a plate was mis-measured.

The calibration certificates for the orifice plates are given as Appendix A.



**Figure 1 Orifice Diameters at 20 °C**

The plates actually used in the meter tube are given in Table 2.

**TABLE 2**

**PLATES USED IN THE METER TUBE AS CONFIGURED BY THE FLOW COMPUTER**

Configuration	25/05/2006	07/02/2007	07/08/2007	08/04/2008	15/04/2008
Orifice plate bore diameter (mm)	188.113	187.9295	187.9295	187.9295	188.113
Expansion coefficient of the plate (/°C)	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05
Orifice plate calibration temperature	20	20	20	20	20
Meter tube diameter (mm)	254.482605	254.482605	254.5079956	254.5079956	254.5079956
Expansion coefficient of the meter tube (/°C)	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05
Meter tube calibration temperature	20	20	20	20	20
Isentropic Exponent	1.321	1.2958	1.2958	1.2972	1.2972
Dynamic Viscosity (Pa.s)	0.0000116	0.0000109	0.0000109	0.000011	0.000011
Orifice plate certificate number	OP60082	OP70023	OP70023	OP70023	OP80012
Orifice plate serial number	0188-105	0005/HY001	0005/HY001	0005/HY001	0005/HY001
Error in orifice diameter?	No	Yes	Yes	Yes	No

The orifice plate calibration temperature has been entered wrongly as 20°C in the configurations of 07/02/2007, 07/08/2007 and 08/04/2008. The entered meter tube diameter changed on 07/08/2007 (254.4826 mm at 20 °C is the figure given in the NTS Offtake Installation Description for SMER). From the data taken at four-minute intervals from 06/02/2007 and 07/07/2007 it is clear that the plate was changed on 06/02/2007. On 15/04/2008 the plate 0005/HY001 was removed from the line after 09:25, recalibrated and put back in the line before 15:18. The correction due to orifice-diameter mis-measurement alone (not wrong temperature entry or wrong pipe-diameter entry) has been calculated.

### 3 CORRECTING THE FLOWRATE

To correct the measured flowrate by replacing an incorrect diameter with the correct diameter might appear to be fairly straightforward. However, the data supplied only give time to the nearest minute and at four-minute intervals. This is inadequate for very accurate calculation. It is possible to calculate the flow over each time interval and to add the values over a day; this method can be used to check that the calculations are being done correctly, but the differences between the summed figures and the ones already given in the spreadsheet are too large to enable the correction to be calculated in this way. An alternative method has therefore been used.

The mass flowrate  $q_m$  is given by

$$q_m = \frac{\pi d^2 C \varepsilon \sqrt{2 \rho \Delta p}}{4 \sqrt{1 - \beta^4}}$$

where  $d$  is the orifice diameter,  $C$  is the discharge coefficient,  $\varepsilon$  is the expansibility,  $\rho$  is the density,  $\Delta p$  is the differential pressure, and  $\beta$  is the diameter ratio.

If the corrected and original data are described with subscripts  $c$  and  $o$ , then the following correction factor is obtained:

$$\frac{q_{m,c}}{q_{m,o}} = \left( \frac{d_c}{d_o} \right)^2 \frac{C_c \varepsilon_c}{C_o \varepsilon_o} \sqrt{\frac{1 - \beta_o^4}{1 - \beta_c^4}}$$

The correct effective diameter is taken as the average of the measurements shown in Table 1 for that plate excluding the erroneous measurement. It is then necessary to calculate  $C$  and  $\varepsilon$  in each case, and they were determined from the equations in ISO 5167-1:1991.  $C$  is a function of  $\beta$  and  $Re_D$ ; so there is a change in  $C$  due to  $\beta$ , but the change varies with Reynolds number. Throughout the calculations the upstream pressure  $p_1$  is taken as 28 bar a; the change in  $q_{m,c}/q_{m,o}$  due to changing the static pressure by 10 bar is around 0.00007%.

Over the period from 06/02/2007 to 07/08/2007 the correction can be calculated as in Table 3; throughout this calculation the meter tube diameter is 254.4826 mm, the isentropic exponent is 1.2958 and the dynamic viscosity 0.0000109 Pa s.

**TABLE 3**

**THE CORRECTION FROM 06/02/2007 TO 07/08/2007**

	$d$ mm	$\beta$	$\varepsilon$	$Re_D$	$C$	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=5$ mbar	187.92649	0.738465	0.999929	1428393	0.599621	
Corrected $\Delta p=5$ mbar	188.11325	0.739199	0.999929	1432256	0.599544	1.0027043
Original $\Delta p=250$ mbar	187.92649	0.738465	0.996458	10051757	0.598822	
Corrected $\Delta p=250$ mbar	188.11325	0.739199	0.996455	10078904	0.598744	1.0027007

So  $q_{m,c}/q_{m,o}$  is 1.002702.



Over the period from 07/08/2007 to 08/04/2008 the correction can be calculated as in Table 4; throughout this calculation the meter tube diameter is 254.5080 mm, the isentropic exponent is 1.2958 and the dynamic viscosity 0.0000109 Pa s.

**TABLE 4**  
**THE CORRECTION FROM 07/08/2007 TO 08/04/2008**

	$d$ mm	$\beta$	$\varepsilon$	$Re_D$	$C$	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=5$ mbar	187.92649	0.738391	0.999929	1428147	0.599629	
Corrected $\Delta p=5$ mbar	188.11325	0.739125	0.999929	1432009	0.599551	1.0027040
Original $\Delta p=250$ mbar	187.92649	0.738391	0.996458	10050034	0.598829	
Corrected $\Delta p=250$ mbar	188.11325	0.739125	0.996455	10077173	0.598752	1.0027004

So  $q_{m,c}/q_{m,o}$  is 1.002702.

Over the period from 08/04/2008 to 15/04/2008 the correction can be calculated as in Table 5; throughout this calculation the meter tube diameter is 254.5080 mm, the isentropic exponent is 1.2972 and the dynamic viscosity 0.000011 Pa s.

**TABLE 5**  
**THE CORRECTION FROM 08/04/2008 TO 15/04/2008**

	$d$ mm	$\beta$	$\varepsilon$	$Re_D$	$C$	$\frac{q_{m,c}}{q_{m,o}}$
Original: $\Delta p=5$ mbar	187.92649	0.738391	0.999929	1415181	0.599636	
Corrected $\Delta p=5$ mbar	188.11325	0.739125	0.999929	1419008	0.599559	1.0027040
Original $\Delta p=250$ mbar	187.92649	0.738391	0.996462	9958736	0.598831	
Corrected $\Delta p=250$ mbar	188.11325	0.739125	0.996459	9985629	0.598753	1.0027004

So  $q_{m,c}/q_{m,o}$  is 1.002702.

#### 4 CORRECTIONS ON A DAILY BASIS

The volume flows for each day from 06/02/2007 to 15/04/2008 are given in Table B.1 of Appendix B together with the corrected values. It has been assumed that the plate that caused the error was inserted and removed at 10:00; therefore 85.2% of the flow for 06/02/2007 has to be corrected and 37.0% for 15/04/2008 based on the flow before and after 10:00. Summing the data gives the figures in Table 6.

**TABLE 6****THE FLOW OVER THE PERIOD 06/02/2007 TO 15/04/2008 INCLUSIVE**

Flow (mscm)	40.81262
Correction (mscm)	0.10994
Corrected flow (mscm)	40.92256
% Change	0.2694

**5 CONCLUSIONS**

A correction factor of 1.002702 should be applied during the period of mis-measurement.

**APPENDIX A  
ORIFICE PLATE CALIBRATION CERTIFICATES  
AND PHOTOGRAPH OF PART OF ONE PLATE**

***NATIONAL GRID ORIFICE PLATE CALIBRATION***

**DATE:** 25-05-06  
**REF NO:** OP60082  
**TEMPERATURE:** 20 degsC

**MEASURED ORIFICE BORE:** 188.113mm

PLATE DETAILS

PLATE SERIAL.	0188-105	PLATE O.D	271.384mm	SITE:	HYDES PASTURE
MANUFACTURER:		PIPE I.D:	mm	FLOW:	
MATERIAL CERT.No.	0005	DESIGN BORE:	mm		

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02  
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 14/10/06

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5		
FLATNESS %	0.198	0.117	0.037	0.042	0.243	0.112	0.163
E' mm	3.268	3.268	3.265	3.262	3.263	3.265	3.267
'e' mm							
EDGE SHARPNESS mm	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
BEVEL ANGLE:	DEGS						
CONCENTRICITY	0.086mm						
SURFACE FINISH (Ra)	0.6 microns						

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.047mm TAPER: 0 degs

COMMENTS:

INSPECTED BY



P. KENNERSON



NATIONAL GRID ORIFICE PLATE CALIBRATION

DATE: 06-02-07  
 REF NO: OP70023  
 TEMPERATURE: 21 degsC

MEASURED ORIFICE BORE: 187.9295mm

PLATE DETAILS

PLATE SERIAL. 0005 PLATE O.D 271.188mm  
 MANUFACTURER: PIPE I.D: mm SITE: HYDES PASTURE  
 MATERIAL CERT.No. DESIGN BORE: mm FLOW:

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02  
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, CERT:- 4820 NEXT CAL DUE:- 13/10/07

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS %	0.127	0.080	0.036	0.050	0.268	0.021	0.072	0.366
'E' mm	3.325	3.332	3.251	3.251	3.305	3.310	3.254	3.243
'e' mm								
EDGE SHARPNESS mm	0.025	0.025	0.0125	0.0125	0.0125	0.025	0.025	0.025
BEVEL ANGLE:	DEGS							
CONCENTRICITY	0.095mm							
SURFACE FINISH (Ra)	0.4 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.127mm	TAPER:		0 degs				

COMMENTS

INSPECTED BY:  P. KENNERSON

## NATIONAL GRID ORIFICE PLATE CALIBRATION

**DATE:** 15-APRIL-2008

**REF NO:** OP80012

**TEMPERATURE:** 20 degsC

**MEASURED ORIFICE BORE:** 188.113mm

**PLATE DETAILS**

PLATE SERIAL:	HY001	PLATE O.D	283.570mm	SITE:	HYDE
MANUFACTURER:	DANIEL DVS	PIPE I.D:	NKmm	FLOW:	M <sup>3</sup> /DAY
MATERIAL CERT.No.	NK	DESIGN BORE:	NKmm		

**TEST EQUIPMENT**

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02  
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS TRACEABLE CERT:- 7325. NEXT CAL DUE:- 02-OCTOBER-2010

**UPSTREAM FACE INSPECTION RESULTS (ISO 5167)**

STATIONS	1	2	3	4	5	6	7	8
FLATNESS %	0.241	0.095	0.025	0.020	0.226	0.101	0.119	0.288
E mm	3.267	3.271	3.268	3.266	3.261	3.259	3.261	3.255
EDGE SHARPNESS mm	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375
BEVEL ANGLE								
CONCENTRICITY	0.100mm							
SURFACE FINISH (Ra)	0.3 microns							
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS								
ROUNDNESS	0.046mm	TAPER:	0 degs					

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: FINE BLACK DUST EVIDENT ON PLATE

INSPECTED BY:  M Livingstone

## NATIONAL GRID ORIFICE PLATE CALIBRATION

**DATE:** 11-FEB-2009

**REF NO:** OP90006

**TEMPERATURE:** 20.5 degsC

**MEASURED ORIFICE BORE:** 188.115mm

=====

PLATE DETAILS

PLATE SERIAL.	HY001	PLATE O.D	271.367mm	SITE:	HYDES PASTURE
MANUFACTURER:	NOT KNOWN	PIPE I.D:	NOT KNOWNmm	FLOW:	NOT KNOWN M <sup>3</sup> /DAY
MATERIAL CERT.No.	NOT KNOWN	DESIGN BORE:	mm		

=====

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02  
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS CERT:- 6822. NEXT CAL DUE:- 03-OCTOBER-2009

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UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

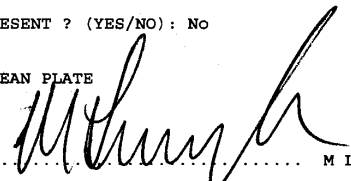
STATIONS:-	1	2	4	5	6		
FLATNESS %	0.198	0.053	0.007	0.049	0.179	0.153	0.199
E' mm	3.262	3.269	3.262	3.260	3.207	3.211	3.260
e' mm							
EDGE SHARPNESS mm	0.0375	0.025	0.0375	0.0375	0.0375	0.025	0.0375
BEVEL ANGLE	DEGS						
CONCENTRICITY	0.047mm						
SURFACE FINISH (Ra)	0.2 microns						

DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.045mm TAPER. 0 degs

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: CLEAN PLATE

INSPECTED BY:  M Livingstone

**NATIONAL GRID ORIFICE PLATE CALIBRATION**

**DATE:** 15-MAY-2009

**REF NO:** OP90012

**TEMPERATURE:** 20.4 degsC

**MEASURED ORIFICE BORE:** 188.1215mm

PLATE DETAILS

PLATE SERIAL.	HY002	PLATE O.D	271.525mm	SITE:	HYDES PASTURE
MANUFACTURER:	ANT	PIPE I.D:	NKmm	FLOW:	NK M <sup>3</sup> /DAY
MATERIAL CERT.No.	ANT22254	DESIGN BORE	NKmm		

TEST EQUIPMENT

MANUFACTURER & TYPE: KEMCO 700 MANUAL 3-DIMENSIONAL MEASURING MACHINE -ASSET NO OP-A02  
 CALIBRATED BY: QUALITY CONTROL TECHNOLOGY, UKAS CERT:- 6822. NEXT CAL DUE:- 03-OCTOBER-2009

UPSTREAM FACE INSPECTION RESULTS (ISO 5167)

STATIONS:-	1	2	3	4	5	6	7	8
FLATNESS %	0.021	0.080	0.146	0.097	0.021	0.050	0.100	0.049
'E' mm	3.225	3.294	3.301	3.257	3.217	3.276	3.285	3.263
'e' mm								
EDGE SHARPNESS mm	0.025	0.025	0.0125	0.0125	SQUARE	SQUARE	0.0125	0.0125
BEVEL ANGLE	DEGS							
CONCENTRICITY	0.030mm							
SURFACE FINISH (Ra)	0.3 microns							

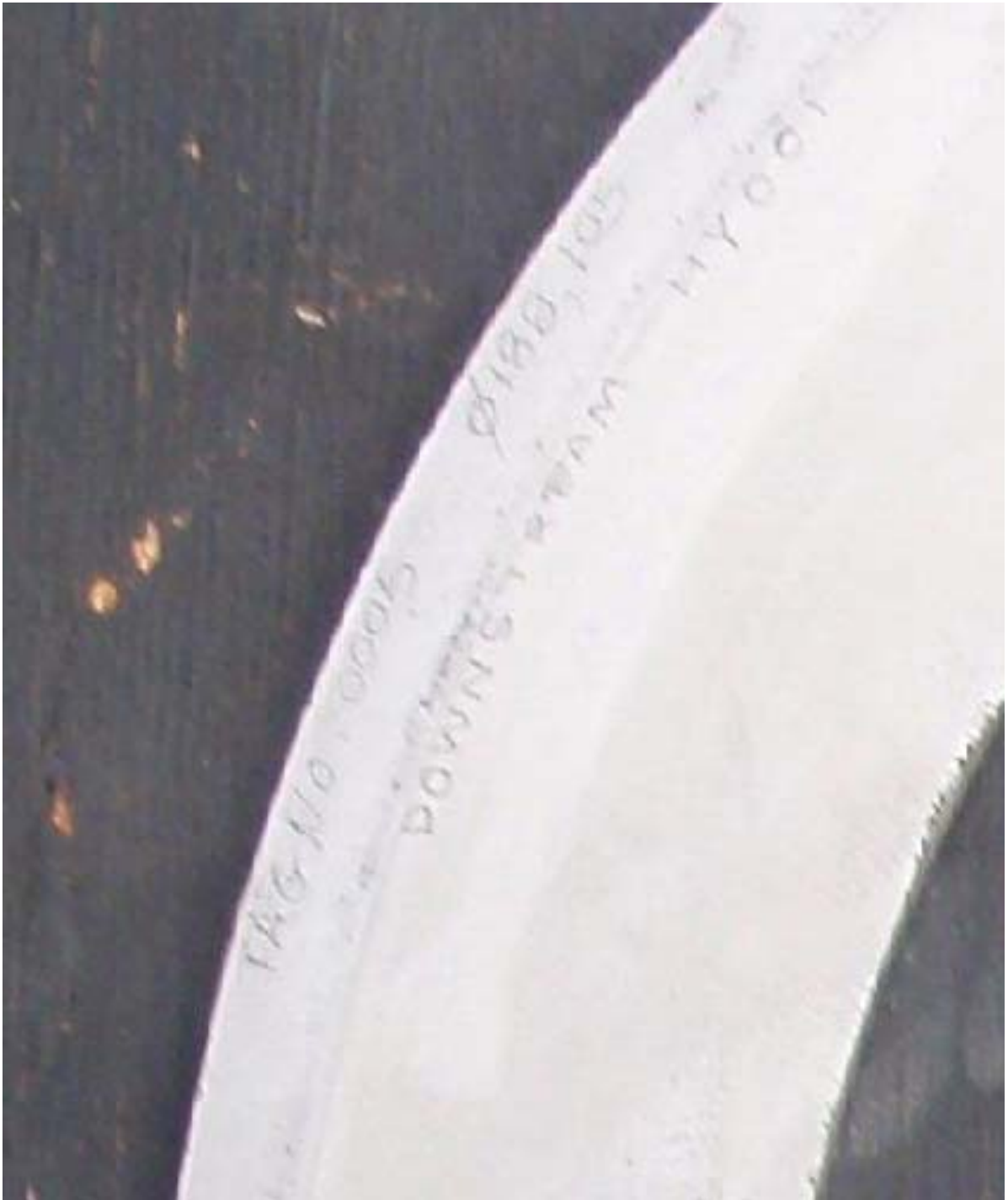
DOWNSTREAM FACE/EDGE VISUAL INSPECTION :- PASS

ROUNDNESS 0.010mm TAPER: 0 degs

DRAINHOLE PRESENT ? (YES/NO): No

COMMENTS: NEW PLATE

INSPECTED BY:  M Livingstone



Photograph of part of orifice plate 0005 and HY001



**APPENDIX B  
CORRECTED DAILY VOLUME FLOWS**

TABLE B.1

**FLOWS AT HYDES PASTURES DURING THE PERIOD OF THE MIS-  
MEASUREMENT**

	<b>Original Values (total)</b>	<b>Corrected values (total)</b>	<b>% increase</b>
<b>Date</b>	<b>Volume (mscm)</b>	<b>Volume (mscm)</b>	<b>Volume (mscm)</b>
6-Feb-2007	0.369219	0.370069	0.2303
7-Feb-2007	0.478438	0.479731	0.2702
8-Feb-2007	0.522888	0.524301	0.2702
9-Feb-2007	0.572401	0.573948	0.2702
10-Feb-2007	0.477730	0.479021	0.2702
11-Feb-2007	0.442711	0.443907	0.2702
12-Feb-2007	0.271447	0.272180	0.2702
13-Feb-2007	0.279421	0.280176	0.2702
14-Feb-2007	0.291009	0.291795	0.2702
15-Feb-2007	0.315266	0.316118	0.2702
16-Feb-2007	0.285363	0.286134	0.2702
17-Feb-2007	0.293678	0.294472	0.2702
18-Feb-2007	0.267072	0.267794	0.2702
19-Feb-2007	0.289640	0.290423	0.2702
20-Feb-2007	0.287453	0.288230	0.2702
21-Feb-2007	0.225183	0.225791	0.2702
22-Feb-2007	0.262623	0.263333	0.2702
23-Feb-2007	0.230110	0.230732	0.2702
24-Feb-2007	0.170758	0.171219	0.2702
25-Feb-2007	0.218989	0.219581	0.2702
26-Feb-2007	0.272442	0.273178	0.2702
27-Feb-2007	0.298626	0.299433	0.2702
28-Feb-2007	0.279476	0.280231	0.2702
1-Mar-2007	0.335676	0.336583	0.2702
2-Mar-2007	0.305218	0.306043	0.2702
3-Mar-2007	0.253012	0.253696	0.2702
4-Mar-2007	0.420824	0.421961	0.2702
5-Mar-2007	0.302685	0.303503	0.2702
6-Mar-2007	0.388892	0.389943	0.2702
7-Mar-2007	0.305732	0.306558	0.2702
8-Mar-2007	0.304202	0.305024	0.2702
9-Mar-2007	0.343862	0.344791	0.2702
10-Mar-2007	0.312494	0.313338	0.2702
11-Mar-2007	0.314777	0.315628	0.2702
12-Mar-2007	0.355499	0.356460	0.2702
13-Mar-2007	0.336404	0.337313	0.2702
14-Mar-2007	0.254941	0.255630	0.2702
15-Mar-2007	0.271701	0.272435	0.2702
16-Mar-2007	0.256399	0.257092	0.2702
17-Mar-2007	0.303491	0.304311	0.2702
18-Mar-2007	0.401317	0.402401	0.2702
19-Mar-2007	0.431261	0.432426	0.2702
20-Mar-2007	0.426591	0.427744	0.2702
21-Mar-2007	0.474855	0.476138	0.2702
22-Mar-2007	0.507144	0.508514	0.2702
23-Mar-2007	0.438405	0.439590	0.2702
24-Mar-2007	0.492826	0.494158	0.2702
25-Mar-2007	0.515316	0.516708	0.2702

26-Mar-2007	0.535274	0.536720	0.2702
27-Mar-2007	0.433318	0.434489	0.2702
28-Mar-2007	0.333209	0.334109	0.2702
29-Mar-2007	0.364013	0.364997	0.2702
30-Mar-2007	0.423080	0.424223	0.2702
31-Mar-2007	0.213854	0.214432	0.2702
1-Apr-2007	0.212000	0.212573	0.2702
2-Apr-2007	0.580532	0.582101	0.2702
3-Apr-2007	0.483541	0.484848	0.2702
4-Apr-2007	0.407550	0.408651	0.2702
5-Apr-2007	0.355349	0.356309	0.2702
6-Apr-2007	0.273068	0.273806	0.2702
7-Apr-2007	0.188553	0.189062	0.2702
8-Apr-2007	0.168920	0.169376	0.2702
9-Apr-2007	0.165088	0.165534	0.2702
10-Apr-2007	0.229211	0.229830	0.2702
11-Apr-2007	0.165132	0.165578	0.2702
12-Apr-2007	0.216936	0.217522	0.2702
13-Apr-2007	0.303149	0.303968	0.2702
14-Apr-2007	0.038869	0.038974	0.2702
15-Apr-2007	0.010382	0.010410	0.2702
16-Apr-2007	0.049009	0.049141	0.2702
17-Apr-2007	0.139632	0.140009	0.2702
18-Apr-2007	0.186228	0.186731	0.2702
19-Apr-2007	0.119921	0.120245	0.2702
20-Apr-2007	0.083946	0.084173	0.2702
21-Apr-2007	0.153319	0.153733	0.2702
22-Apr-2007	0.178498	0.178980	0.2702
23-Apr-2007	0.223204	0.223807	0.2702
24-Apr-2007	0.016182	0.016226	0.2702
25-Apr-2007	0.047213	0.047341	0.2702
26-Apr-2007	0.023770	0.023834	0.2702
27-Apr-2007	0.014964	0.015004	0.2702
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3-May-2007	0.008342	0.008365	0.2702
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28-May-2007	0.037292	0.037393	0.2702
29-May-2007	0.013690	0.013727	0.2702
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19-Sep-2007	0.000749	0.000751	0.2702
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28-Sep-2007	0.005424	0.005439	0.2702
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19-Oct-2007	0.030083	0.030164	0.2702
20-Oct-2007	0.026545	0.026617	0.2702
21-Oct-2007	0.025729	0.025799	0.2702
22-Oct-2007	0.005551	0.005566	0.2702
23-Oct-2007	0.014940	0.014980	0.2702
24-Oct-2007	0.018216	0.018265	0.2702
25-Oct-2007	0.010501	0.010529	0.2702
26-Oct-2007	0.008007	0.008029	0.2702
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6-Nov-2007	0.032878	0.032967	0.2702
7-Nov-2007	0.023173	0.023236	0.2702
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12-Nov-2007	0.031572	0.031657	0.2702
13-Nov-2007	0.000183	0.000183	0.2702
14-Nov-2007	0.033751	0.033842	0.2702
15-Nov-2007	0.032880	0.032969	0.2702
16-Nov-2007	0.041474	0.041586	0.2702
17-Nov-2007	0.005136	0.005150	0.2702
18-Nov-2007	0.019811	0.019865	0.2702
19-Nov-2007	0.036087	0.036185	0.2702
20-Nov-2007	0.008383	0.008406	0.2702

21-Nov-2007	0.015547	0.015589	0.2702
22-Nov-2007	0.007736	0.007757	0.2702
23-Nov-2007	0.066909	0.067090	0.2702
24-Nov-2007	0.102686	0.102963	0.2702
25-Nov-2007	0.024399	0.024465	0.2702
26-Nov-2007	0.040216	0.040325	0.2702
27-Nov-2007	0.011807	0.011839	0.2702
28-Nov-2007	0.019088	0.019140	0.2702
29-Nov-2007	0.002815	0.002823	0.2702
30-Nov-2007	0.000097	0.000097	0.2702
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2-Dec-2007	0.008116	0.008138	0.2702
3-Dec-2007	0.022110	0.022170	0.2702
4-Dec-2007	0.000701	0.000703	0.2702
5-Dec-2007	0.005813	0.005829	0.2702
6-Dec-2007	0.004568	0.004580	0.2702
7-Dec-2007	0.021497	0.021555	0.2702
8-Dec-2007	0.011007	0.011037	0.2702
9-Dec-2007	0.020396	0.020451	0.2702
10-Dec-2007	0.028863	0.028941	0.2702
11-Dec-2007	0.176894	0.177372	0.2702
12-Dec-2007	0.246417	0.247083	0.2702
13-Dec-2007	0.159821	0.160253	0.2702
14-Dec-2007	0.269750	0.270479	0.2702
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17-Dec-2007	0.229084	0.229703	0.2702
18-Dec-2007	0.131839	0.132195	0.2702
19-Dec-2007	0.109999	0.110296	0.2702
20-Dec-2007	0.237572	0.238214	0.2702
21-Dec-2007	0.182295	0.182788	0.2702
22-Dec-2007	0.099140	0.099408	0.2702
23-Dec-2007	0.148852	0.149254	0.2702
24-Dec-2007	0.110645	0.110944	0.2702
25-Dec-2007	0.102516	0.102793	0.2702
26-Dec-2007	0.088209	0.088447	0.2702
27-Dec-2007	0.002235	0.002241	0.2702
28-Dec-2007	0.103627	0.103907	0.2702
29-Dec-2007	0.041725	0.041838	0.2702
30-Dec-2007	0.024339	0.024405	0.2702
31-Dec-2007	0.062388	0.062557	0.2702
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2-Jan-2008	0.118492	0.118812	0.2702
3-Jan-2008	0.263433	0.264145	0.2702
4-Jan-2008	0.248974	0.249647	0.2702
5-Jan-2008	0.246977	0.247644	0.2702
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7-Jan-2008	0.269128	0.269855	0.2702
8-Jan-2008	0.178906	0.179389	0.2702
9-Jan-2008	0.218933	0.219525	0.2702
10-Jan-2008	0.141456	0.141838	0.2702
11-Jan-2008	0.181814	0.182305	0.2702
12-Jan-2008	0.417588	0.418716	0.2702
13-Jan-2008	0.172873	0.173340	0.2702
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17-Jan-2008	0.313051	0.313897	0.2702
18-Jan-2008	0.240101	0.240750	0.2702
19-Jan-2008	0.091562	0.091809	0.2702

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21-Jan-2008	0.096973	0.097235	0.2702
22-Jan-2008	0.238660	0.239305	0.2702
23-Jan-2008	0.141517	0.141899	0.2702
24-Jan-2008	0.162657	0.163096	0.2702
25-Jan-2008	0.133547	0.133908	0.2702
26-Jan-2008	0.051478	0.051617	0.2702
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28-Jan-2008	0.171832	0.172296	0.2702
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2-Feb-2008	0.195412	0.195940	0.2702
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13-Feb-2008	0.111711	0.112013	0.2702
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24-Feb-2008	0.063009	0.063179	0.2702
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26-Feb-2008	0.063115	0.063286	0.2702
27-Feb-2008	0.080355	0.080572	0.2702
28-Feb-2008	0.074851	0.075053	0.2702
29-Feb-2008	0.143995	0.144384	0.2702
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3-Mar-2008	0.097409	0.097672	0.2702
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6-Mar-2008	0.057615	0.057771	0.2702
7-Mar-2008	0.044590	0.044710	0.2702
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13-Mar-2008	0.156439	0.156862	0.2702
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16-Mar-2008	0.082475	0.082698	0.2702
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25-Mar-2008	0.095124	0.095381	0.2702
26-Mar-2008	0.092410	0.092660	0.2702
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30-Mar-2008	0.020982	0.021039	0.2702
31-Mar-2008	0.016842	0.016888	0.2702
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13-Apr-2008	0.046140	0.046265	0.2702
14-Apr-2008	0.183870	0.184367	0.2702
15-Apr-2008	0.112644	0.112756	0.0999