ftn Associates Ltd.
water resources / environmental consultants
3 Innwood Circle • Suite 220 • Little Rock, AR 72211 • (501) 225-7779 • Fax (501) 225-8738

June 6, 2008

Mr. Nick Willis
Arkansas Department of Environmental Quality
5301 Northshore Dr.
North Little Rock, AR 72118-5317

RE: Outfall 028 and Hurricane Creek Mixing Zone CORMIX Model Results
NPDES Permit No. AR0000582
FTN No. 6012-250.O

Dear Mr. Willis:

Alcoa Inc. (Alcoa) is submitting a narrative justification for the proposed discharge tiers at Outfall 028 and the CORMIX model results that have predicted the instream mixing characteristics of Outfall 028's discharge in Hurricane Creek. ADEQ has requested this information to support the National Pollutant Discharge Elimination System (NPDES) permit application and demonstrate that the 111% discharge tier maintains one third of the stream as free passage (below selenium acute criteria).

JUSTIFICATION FOR MODIFYING THE OUTFALL 028 DISCHARGE TIERS

Alcoa's decision to modify Outfall 028's discharge tiers was based on the review of Outfall 028's historical selenium data and the assimilative capacity of Hurricane Creek. During the startup phase of Outfall 028 and in conjunction with the issuance of the existing NPDES permit, Alcoa developed the original discharge tiers based on the predicted selenium discharge concentrations. It has now been determined, by the analysis of the Discharge Monitoring Reports (DMR) data, that the selenium concentrations are lower than Alcoa initially anticipated. The new proposed Outfall 028 hydrograph control release (HCR) tiers are now based on historical selenium data and still maintaining the instream selenium water quality standards. Tiers were calculated by using two thirds of the stream flow and meeting the water quality standard of 5 µg/L in this two thirds of stream flow. The discharge tier steady state model in Appendix A provides these calculations as well as the instream selenium concentration below the mixing zone (total stream flow). A statistical summary of Outfall 028's selenium is presented in Appendix A as well.

OUTFALL 028 AND HURRICANE CREEK CORMIX MODEL RESULTS

FTN Associates, Ltd. used the CORMIX model to simulate the Hurricane Creek and Outfall 028 mixing characteristics during a critical scenario of the 111% discharge tier and low flow. The CORMIX model is a computer simulation developed by United States Environmental Protection Agency to help predict the instream mixing zone characteristics of effluent discharges into natural water bodies.

The CORMIX model predicts that at least one third of the stream will be maintained as a zone of free passage under the proposed discharge scenarios. The CORMIX output data is presented in Appendix A of this letter with a narrative summary below. Two discharge scenarios were computed (2 cfs - critical low flow and 4 cfs - low flow) to help evaluate the mixing zone characteristics.

The CORMIX model run results can be summarized as follows:

- A critical low flow scenario of 2 cfs upstream flow, discharge selenium concentration of 8 ppb, and a discharge flow of 111% of the upstream flow, the concentration in the centerline of the plume diluted to 5 ppb at a lateral distance of 5.9 meters from the discharge side of Hurricane Creek bank. With a total stream width of 18.7 meters, this leaves a zone of passage of approximately 12.8 meters, which equals 68% of the stream available for safe passage.
- A low flow scenario of 4 cfs upstream flow, discharge selenium concentration of 8 ppb, and a discharge flow of 111% of the upstream flow, the concentration in the centerline of the plume diluted to 5 ppb at a lateral distance of 8.1 meters from the discharge side of Hurricane Creek bank. With a total stream width of 18.7 meters, this leaves a zone of passage of approximately 10.6 meters, which equals 56% of the stream available for safe passage.

If you have any questions regarding these comments, please contact me or Phillip Massirer at (501) 225-7779.

Kindest regards,
FTN ASSOCIATES, LTD.

Nathan Siria
Environmental Scientist

NJS/ack

Attachment

R:\WP_FILES\6012-250.O\CORRESPONDENCE\L-N WILLIS 6-05-08\L-N WILLIS 6-06-08 .DOC

APPENDIX A

Selenium Discharge Tiers

Alcoa, Inc - Hurricane Creek (AR0000582)

NPDES Application - Hydrograph Controlled Release (HCR) to Hurricane Creek Operations Model

6/5/2008

Discharge Steady State Mass Balance Model -- Selenium

Input:

Water Quality Standard =	5	ug/L
Hurricane Creek Upstream =	0	ug/L
Hurricane Creek Upstream =	8976	gpm
2/3 Hurricane Creek Flow =	5984	gpm

	Instream Mixing Zone Concentration based on Flow Allocation (mixing zone allocation 2/3rd)			Actual instream mixed concentration (Entire flow)	
	Adjusted Flow (2/3rd of stream flow)	Selenium	Discharge Percent of the Hurricane Creek Flow upstream of the discharge	True Flow	Selenium
Hurricane Creek Discharge	gpm	ug/L	%	gpm	ug/L
Tier 1					
Outfall 028	9,973	8.0		9,973	8.0
Hurricane Creek Upstream	5,984	-		8,976	-
Hurricane Creek mixed with Discharge	15,957	5.0	111	18,949	4.2
Tier 2					
Outfall 028	5,984	10.0		5,984	10.0
Hurricane Creek Upstream	5,984	-		8,976	-
Hurricane Creek mixed with Discharge	11,968	5.0	67	14,960	4.0
Tier 3					
Outfall 028	4,274	12.0		4,274	12.0
Hurricane Creek Upstream	5,984	-		8,976	-
Hurricane Creek mixed with Discharge	10,258	5.0	48	13,250	3.9
Tier 4					
Outfall 028	2,720	16.0		2,720	16.0
Hurricane Creek Upstream	5,984	-		8,976	-
Hurricane Creek mixed with Discharge	8,704	5.0	30	11,696	3.7
Tier 5					
Outfall 028	1,496	25.0		1,496	25.0
Hurricane Creek Upstream	5,984	-		8,976	-
Hurricane Creek mixed with Discharge	7,480	5.0	17	10,472	3.6

	Se
Longterm Data	ug/l
Min	2.8
Avg	9.9
Max	17.0
Samples	142
2-year Data	
Min	3.6
Avg	10
Max	17.0
Samples	87

Percent of time that concentrations are below a concentration	
25	7.5
40	8.5
50	9.6
60	10.6
75	13.0
80	14.0
95	15.0

APPENDIX B

CORMIX Model Output

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
SITE NAME/LABEL:                  Hurricane Creek at Outfall 028
  Design case:                    Low Flow - 2 cfs upstream
  FILE NAME:                      HURR2CFS
  Using subsystem CORMIX3:        Buoyant Surface Discharges
  Start of session:               06/05/08--11:54:39
******************************************************************************
SUMMARY OF INPUT DATA:
------------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                            = bounded
  Width                           BS       =          18.7 m
  Channel regularity              ICHREG = 2
  Ambient flowrate                QA       =          0.05 m^3/s
  Average depth                   HA       =          0.89 m
  Depth at discharge              HD       =          0.89 m
  Ambient velocity                UA       =        0.0034 m/s
  Darcy-Weisbach friction factor  F        =        0.0734
    Calculated from Manning's n            =          0.03
  Wind velocity                   UW       =             1 m/s
Stratification Type               STRCND = U
  Surface temperature                      =            30 degC
  Bottom temperature                       =            30 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                 RHOAS    =      995.6470 kg/m^3
  Bottom density                  RHOAB    =      995.6470 kg/m^3
------------------------------------------------------------------------------
DISCHARGE PARAMETERS:             Buoyant Surface Discharge
  Discharge located on                     = left bank/shoreline
  Discharge configuration                  = flush discharge
  Distance from bank to outlet    DISTB    =           0.0 m
  Discharge angle                 SIGMA    =            90 deg
  Depth near discharge outlet     HD0      =           0.2 m
  Bottom slope at discharge       SLOPE    =            11 deg
  Rectangular discharge:
    Discharge cross-section area  A0       =        0.2700 m^2
    Discharge channel width       B0       =           1.8 m
    Discharge channel depth       H0       =          0.15 m
    Discharge aspect ratio        AR       =          0.08
  Discharge flowrate              Q0       =      0.062991 m^3/s
  Discharge velocity              U0       =          0.23 m/s
  Discharge temperature (freshwater)       =            30 degC
    Corresponding density         RHO0     =      995.6470 kg/m^3
  Density difference              DRHO     =             0 kg/m^3
  Buoyant acceleration            GP0      =         .0000 m/s^2
  Discharge concentration         C0       =                  8 ppb
  Surface heat exchange coeff.    KS       =             0 m/s
  Coefficient of decay            KD       =             0 /s
------------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  =       0.51 m         Lm   =      35.39 m          Lb   =          0.0 m
  LM  =    99999.0 m
------------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number        FR0    =    99999.0 (based on LQ)
  Channel densimetric Froude no.   FRCH   =    99999.0 (based on H0)
  Velocity ratio                   R      =      68.11
-------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = yes
  Water quality standard           CSTD    =                5 ppb
  Regulatory mixing zone                   = yes
  Regulatory mixing zone specification     = width
  Regulatory mixing zone value             =        12.52 m (m^2 if area)
  Region of interest                       =       200.00 m
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS    =     SA2 |
  *-------------------------*
*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):
-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at water surface and at centerline of discharge channel:
            0.0 m from the left bank/shore.
-------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no reg
  implication.  However, this information may be useful for the di
  designer because the mixing in the NFR is usually sensitive to t
  discharge design conditions.
  Pollutant concentration at edge of NFR =          2.6464 ppb
  Dilution at edge of NFR                =          3.0
  NFR Location:                        x =         43.44 m
    (centerline coordinates)           y =        -38.56 m
                                       z =          .00 m
  NFR plume dimensions:        half-width =         20.23 m
                                thickness =          .89 m
Buoyancy assessment:
  The effluent density is equal or about about equal to the surrounding
  ambient water density at the discharge level.
  Therefore, the effluent behaves essentially as NEUTRALLY BUOYANT.

-------------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at          .00 m
  downstream and continues as vertically mixed into the far-field.

********************** TOXIC DILUTION ZONE SUMMARY ************************
No TDZ was specified for this simulation.

********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration                =        2.776571 ppb
  Corresponding dilution                 =          2.8
  Plume location:                      x =         18.45 m
```

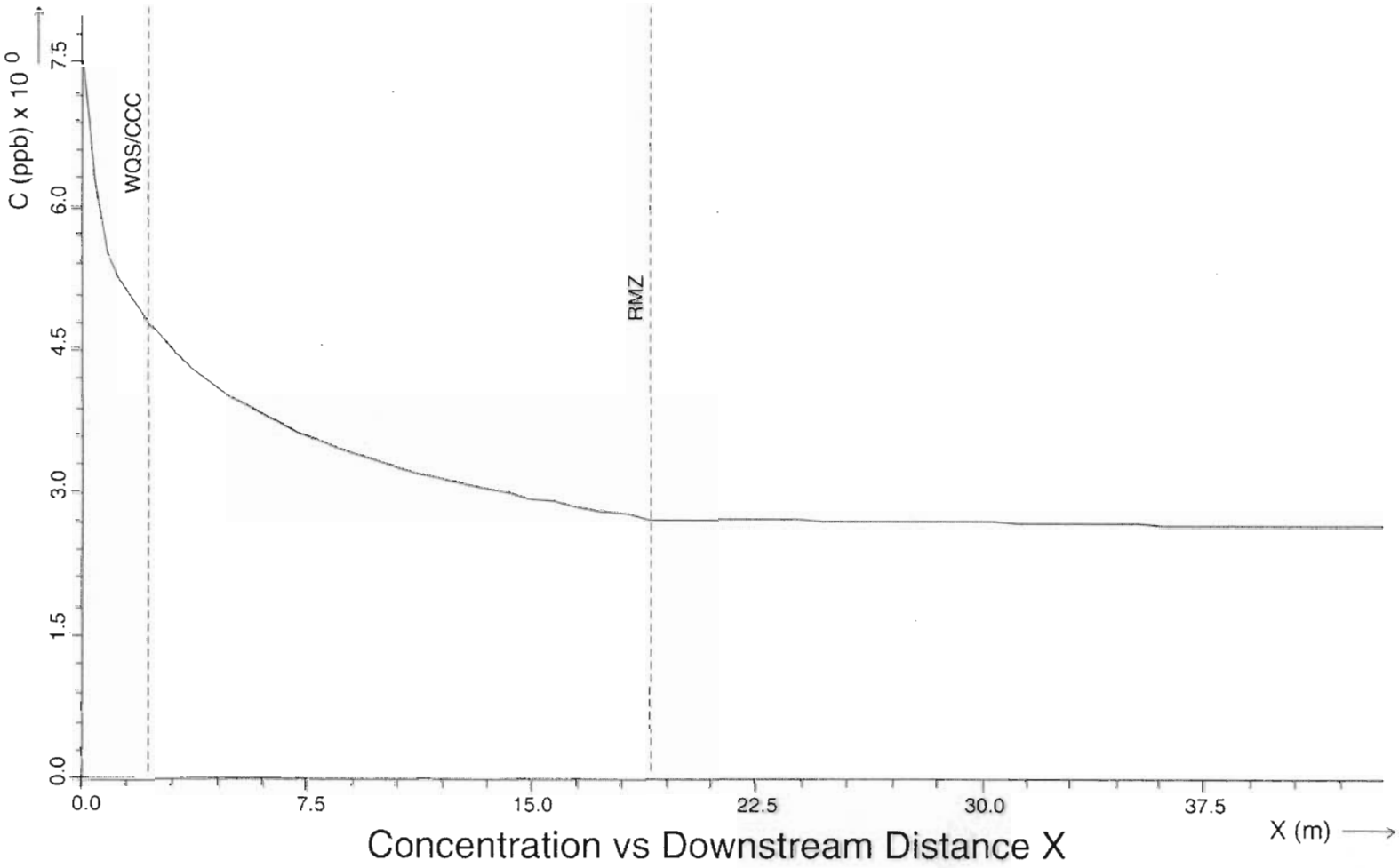
```
|    (centerline coordinates)          y =       -29.85 m                    |
|                                      z =          .00 m                    |
|  Plume dimensions:           half-width =         6.26 m                    |
|                               thickness =          .89 m                    |
|At this position, the plume is CONTACTING the LEFT bank.                    |
|Furthermore, the specified water quality standard has indeed been met       |
|  within the RMZ. In particular:                                            |
|The ambient water quality standard was encountered at the following         |
|  plume position:                                                           |
|  Water quality standard                =                 5 ppb             |
|  Corresponding dilution                =         1.6                     |
|  Plume location:                     x =         1.70 m                    |
|    (centerline coordinates)          y =        -5.90 m                    |
|                                      z =          .00 m                    |
|  Plume dimensions:           half-width =         1.68 m                    |
|                               thickness =          .89 m                    |
|                                                                            |
|END OF SUMMARY.....                                                         |
+----------------------------------------------------------------------------+
```

Hurricane^Creek^at^Outfall^028

Low^Flow^-^2^cfs^upstream

CORMIX3 Prediction

File: sim\HURR2CFS.cx3/



Concentration vs Downstream Distance X

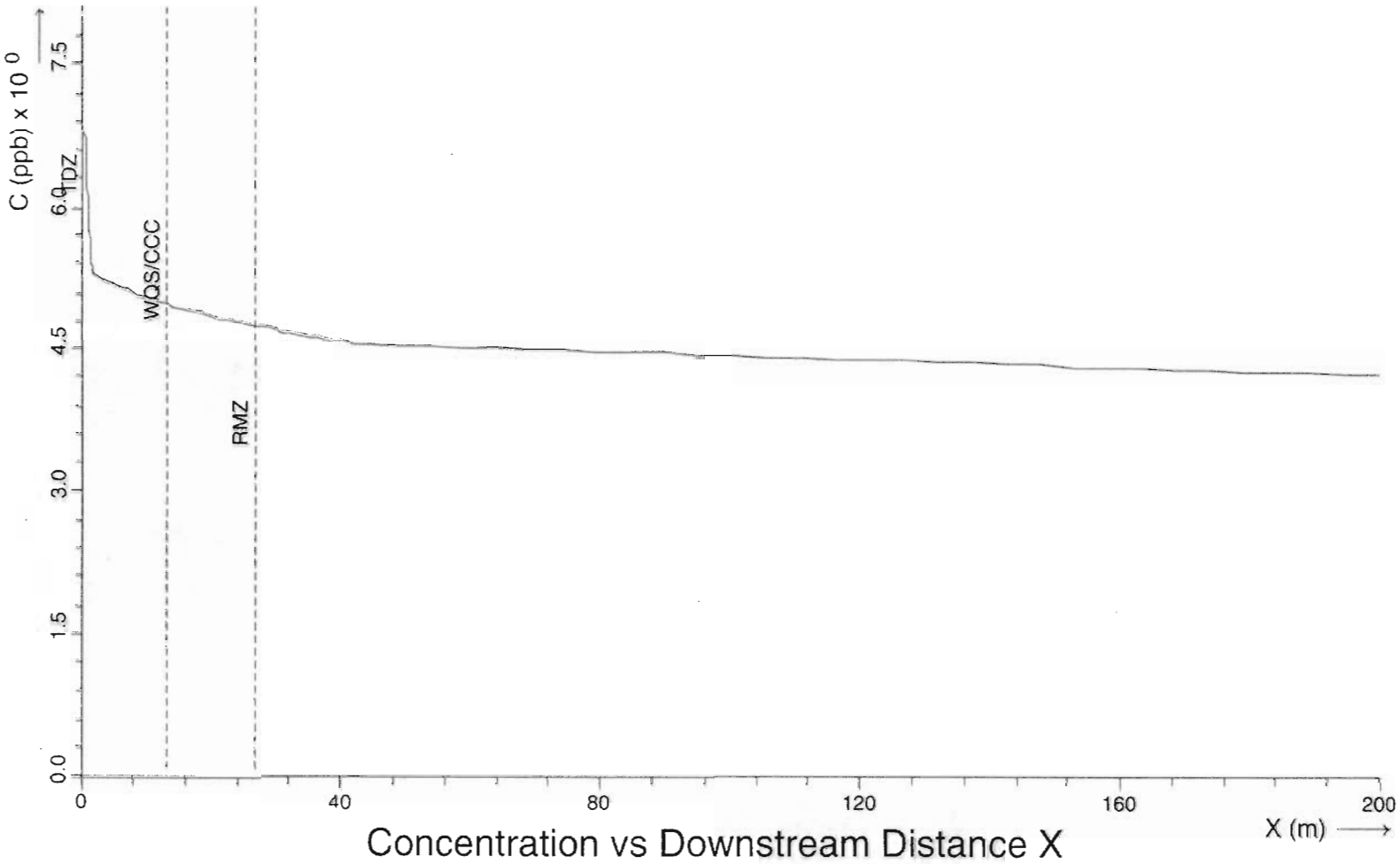
```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
SITE NAME/LABEL:                 Hurricane Creek at Outfall 028
  Design case:                   Higher Flow - 4 cfs upstream
  FILE NAME:                     HUR 4CFS
  Using subsystem CORMIX3:       Buoyant Surface Discharges
  Start of session:              06/05/08--11:27:51
*******************************************************************************
SUMMARY OF INPUT DATA:
-------------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                          BS      =          18.7 m
  Channel regularity             ICHREG  = 2
  Ambient flowrate               QA      =          0.11 m^3/s
  Average depth                  HA      =          0.89 m
  Depth at discharge             HD      =          0.89 m
  Ambient velocity               UA      =        0.0066 m/s
  Darcy-Weisbach friction factor F       =        0.0734
    Calculated from Manning's n          =          0.03
  Wind velocity                  UW      =             1 m/s
Stratification Type              STRCND  = U
  Surface temperature                    =            30 degC
  Bottom temperature                     =            30 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                RHOAS   =      995.6470 kg/m^3
  Bottom density                 RHOAB   =      995.6470 kg/m^3
-------------------------------------------------------------------------------
DISCHARGE PARAMETERS:            Buoyant Surface Discharge
  Discharge located on                   = left bank/shoreline
  Discharge configuration                = flush discharge
  Distance from bank to outlet   DISTB   =           0.0 m
  Discharge angle                SIGMA   =            90 deg
  Depth near discharge outlet    HD0     =           0.2 m
  Bottom slope at discharge      SLOPE   =            11 deg
  Rectangular discharge:
    Discharge cross-section area A0      =        0.3420 m^2
    Discharge channel width      B0      =           1.8 m
    Discharge channel depth      H0      =          0.19 m
    Discharge aspect ratio       AR      =          0.10
  Discharge flowrate             Q0      =      0.121991 m^3/s
  Discharge velocity             U0      =          0.35 m/s
  Discharge temperature (freshwater)     =            30 degC
    Corresponding density        RHO0    =      995.6470 kg/m^3
  Density difference             DRHO    =             0 kg/m^3
  Buoyant acceleration           GP0     =         .0000 m/s^2
  Discharge concentration        C0      =                 8 ppb
  Surface heat exchange coeff.   KS      =             0 m/s
  Coefficient of decay           KD      =             0 /s
-------------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  =       0.58 m         Lm  =      31.56 m         Lb  =        0.0 m
  LM  =    99999.0 m
-------------------------------------------------------------------------------
```

```
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number       FR0    =    99999.0 (based on LQ)
  Channel densimetric Froude no.  FRCH   =    99999.0 (based on H0)
  Velocity ratio                  R      =      53.97
-------------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                          = no
  Water quality standard specified         = yes
  Water quality standard          CSTD     =                5 ppb
  Regulatory mixing zone                   = yes
  Regulatory mixing zone specification     = width
  Regulatory mixing zone value             =        12.52 m (m^2 if area)
  Region of interest                       =       200.00 m
*******************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *-------------------------*
  | FLOW CLASS    =     SA2 |
  *-------------------------*
*******************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):
-------------------------------------------------------------------------------
X-Y-Z Coordinate system:
  Origin is located at water surface and at centerline of discharge channel:
            0.0 m from the left bank/shore.
-------------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing.  It has no regulatory
  implication.  However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at edge of NFR =          3.4094 ppb
  Dilution at edge of NFR                =         2.3
  NFR Location:                        x =        43.39 m
    (centerline coordinates)           y =       -30.62 m
                                       z =          .00 m
  NFR plume dimensions:       half-width =        15.95 m
                               thickness =          .89 m
Buoyancy assessment:
  The effluent density is equal or about about equal to the surrounding
  ambient water density at the discharge level.
  Therefore, the effluent behaves essentially as NEUTRALLY BUOYANT.

-------------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed ALREADY IN NEAR-FIELD at         .00 m
  downstream and continues as vertically mixed into the far-field.

********************** TOXIC DILUTION ZONE SUMMARY ***********************
No TDZ was specified for this simulation.

********************** REGULATORY MIXING ZONE SUMMARY **********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration                =        4.310876 ppb
  Corresponding dilution                 =          1.7
  Plume location:                      x =       -59.38 m
```

```
|    (centerline coordinates)          y =         8.15 m                  |
|                                      z =          .00 m                  |
|  Plume dimensions:          half-width =         6.26 m                  |
|                              thickness =          .89 m                  |
|At this position, the plume is CONTACTING the LEFT bank.                  |
|Furthermore, the specified water quality standard has indeed been met     |
|  within the RMZ. In particular:                                          |
|The ambient water quality standard was encountered at the following       |
|  plume position:                                                         |
|  Water quality standard                =                5 ppb            |
|  Corresponding dilution                =         1.6                    |
|  Plume location:                     x =         3.31 m                  |
|    (centerline coordinates)          y =        -8.07 m                  |
|                                      z =          .00 m                  |
|  Plume dimensions:          half-width =         1.98 m                  |
|                              thickness =          .89 m                  |
|                                                                          |
|END OF SUMMARY.............................................               |
```

Hurricane^Creek^at^Outfall^028
Higher^Flow^-^4^cfs^upstream

CORMIX3 Prediction
File: sim\HURR4CFS.cx3/



Concentration vs Downstream Distance X

Willis, Nicholas

From: Nathan Siria [njs@ftn-assoc.com]
Sent: Friday, June 06, 2008 3:59 PM
To: Willis, Nicholas; Pat Keogh; Gross, Robyn L.; Matt Burnham; Jim Malcolm
Subject: Alcoa (AR0000538) Outfall 028 technical information

L-N Willis 6-06-08.pdf (380 K.

Nick,

As requested, attached is the Outfall 028 and Hurricane Creek mixing zone CORMIX model results summarized. If you have any questions, please feel free to contact me or Pat Keogh.

Nathan Siria
FTN Associates
501-225-7779

Willis, Nicholas wrote:
> Nathan,
>
> Give me a couple of days into next week so I can write the second
> in-house draft after I have reviewed the models. I would hate for a
> mistake of mine to bring up a contentious issue on an otherwise
> non-existent point.
>
> Would this work fine?
>
> Nicholas Willis
> Water Permits Branch
> Phone: 501-682-0619
> Fax: 501-682-0910
> willis@adeq.state.ar.us
>
> -----Original Message-----
> From: Nathan Siria [mailto:njs@ftn-assoc.com]
> Sent: Thursday, June 05, 2008 4:40 PM
> To: Willis, Nicholas
> Subject: Re: Modeling update
>
> We are writing the letter with the model runs at this moment. We
> should
> have something for you tomorrow. Sorry for the delay.
>
> Thanks for checking.
>
> Can Alcoa review the draft permit as it is?
>
> Nathan
>
> Willis, Nicholas wrote:
>
>> Nathan,
>>
>>
>>
>> What is the status of the mixing zone modeling?
>>
>>
>>

>> Thanks,
>>
>>
>>
>> Nicholas Willis
>>
>> Water Permits Branch
>>
>> Phone: 501-682-0619
>>
>> Fax: 501-682-0910
>>
>> willis@adeq.state.ar.us
>>
>>
>>
>>
>
>

Willis, Nicholas

From: Willis, Nicholas
Sent: Thursday, June 05, 2008 4:47 PM
To: 'Nathan Siria'
Subject: RE: Modeling update

Nathan,

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Would this work fine?

Nicholas Willis
Water Permits Branch
Phone: 501-682-0619
Fax: 501-682-0910
willis@adeq.state.ar.us

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From: Nathan Siria [mailto:njs@ftn-assoc.com]
Sent: Thursday, June 05, 2008 4:40 PM
To: Willis, Nicholas
Subject: Re: Modeling update

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Nathan

Willis, Nicholas wrote:
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>
>
> What is the status of the mixing zone modeling?
>
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> Thanks,
>
>
>
> Nicholas Willis
>
> Water Permits Branch
>
> Phone: 501-682-0619
>
> Fax: 501-682-0910
>
> willis@adeq.state.ar.us
>
>
>

Willis, Nicholas

From: Willis, Nicholas
Sent: Thursday, June 05, 2008 4:31 PM
To: 'Nathan Siria'
Subject: Modeling update

Nathan,

What is the status of the mixing zone modeling?

Thanks,

Nicholas Willis
Water Permits Branch
Phone: 501-682-0619
Fax: 501-682-0910
willis@adeq.state.ar.us