Addendum to Wasteload Evaluation for City of Skiatook and Town of Sperry

Lower Hominy Creek
OKWBID # OK121300040010_00

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1. Purpose of WLA Report Addendum

In February 2013 INCOG submitted a first draft Wasteload Allocation (WLA) modeling report to ODEQ for technical review. INCOG performed the modeling on behalf of the City of Skiatook which is planning to decommission its Bird Creek Wastewater Treatment Facility (WWTF) and divert raw influent to its existing Hominy Creek WWTF. An increase in capacity at the Hominy Creek WWTF is needed for this purpose, and additional capacity was calculated for future growth. Modeling of Skiatook was therefore performed for 2.5 MGD. Since the Town of Sperry discharges approximately 5 miles downstream of Skiatook WWTF, INCOG approached Sperry about any future increased demands.

Sperry indicated that they desired an increased flow to 0.25 MGD to accommodate future demands, so INCOG's 2013 draft WLA report recommended WLA limits for Sperry at 0.25 MGD. During technical reviews by ODEQ and EPA, ODEQ requested confirmation of Sperry's flow increase needs, such as from population projections or by other methods. INCOG prepared a revised report in 2014 that addressed ODEQ's technical comments. However, using the normal sources available for

assessing future growth, Sperry was unable to justify the population growth anticipated by Sperry officials, their consultants and INCOG. In order to expedite the WLA for Skiatook, it was agreed in 2015 by all parties that INCOG would perform remodeling of Hominy Creek with Sperry modeled at their existing WLAs assigned in the present 208 Plan (secondary lagoon for all seasons at 0.132 MGD).

In September 2015 INCOG performed the seasonal remodeling, and ODEQ reviewed and approved the model changes. Since Sperry was modeled at their existing 208 Plan WLAs, there is no need for processing a change to the 208 Plan for Sperry. Results of this remodeling are presented in this Addendum report. Refer to the August 2014 revised modeling WLA report for additional information about Skiatook and Sperry model constructs and additional background and justifications used in the modeling.

The following changes were made to the seasonal models used in the August 2014 WLA report:

1. Headwater flows were adjusted slightly higher because the 2014 calculated headwater flows were based upon Sperry at 0.25 MGD. Reverting back to 0.132 MGD meant that slightly less flow should be subtracted from the Corps seasonal agreement flows.

2. Sperry discharge design flow was reduced from 0.25 MGD to 0.132 MGD.

3. Sperry effluent dissolved oxygen (DO) was set to secondary limits of 2.0 mg/L for all seasons.

No other changes were made to the models. INCOG used the same LAQUAL model ver. 9.05 used in the previous reports and the same data entry and output reporting methods. INCOG also used the same Margin of Safety (MOS) spreadsheets used in the previous modeling, only with the Sperry and headwater adjustments identified above. ODEQ reviewed all model inputs, outputs and spreadsheets and approved the changes.

2. Changes to Endpoint Identification

There have been no changes to endpoint DO criteria for any season, therefore the same DO targets used in the 2014 report were used in this remodeling.

The following numerical dissolved oxygen criteria for WWAC apply to lower Hominy Creek:

	Critical Low-Flow Condition
Summer (Jun–Oct):	5.0 mg/L
Spring (Apr–May):	6.0 mg/L
Winter (Nov–Mar):	6.0 mg/L

Refer to the 2014 report for a complete explanation of headwater flow calculations. Each season's headwater flow for lower Hominy Creek was re-calculated by taking the Corps of Engineers seasonal agreement flows minus the future design flow of Skiatook and minus the existing 208 Plan design flow of Sperry (2.50 MGD and 0.132 MGD, respectively) and minus the 7Q2 seasonal flows from the Avant gage. The revised seasonal headwater flows used in the remodeling are:

- Summer: 128.3 cfs
- Spring: 80.9 cfs
- Winter: 38.0 cfs

3. Source Analysis

3.1. Point Sources

Skiatook West (WWTF)

Facility Legal Description:	W/2 NE S33 T22N R12E
Receiving Stream:	Hominy Creek
Point of Discharge (POD)	SW SE SE S33 T22N R12E

Current Wasteload Allocation (WLA):

Permitted Flow:	0.9 MGD
Summer (Jun - Oct):	Secondary
Spring (Apr - May):	Secondary
Winter (Nov - Mar):	Secondary

Skiatook Bird Creek (WWTF)

Facility Legal Description:	SW NW NW S25 T22N R12E
Receiving Stream:	Bird Creek
Point of Discharge (POD)	SW NW NW S25 T22N R12E

Current Wasteload Allocation (WLA):

Permitted Flow:	0.35 MGD
Summer (Jun - Oct):	Secondary
Spring (Apr - May):	Secondary
Winter (Nov - Mar):	Secondary

Sperry (WWTF)

Facility Legal Description:	NW NW NW S13 T21N R12E
Receiving Stream:	Hominy Creek
Point of Discharge (POD)	NW NW NW S13 T21N R12E

Current Wasteload Allocation (WLA):

Permitted Flow:	0.132 MGD
Summer (Jun - Oct):	Secondary
Spring (Apr - May):	Secondary
Winter (Nov - Mar):	Secondary

No changes were made to Section 3.1 Point Sources presented in the 2014 report.

3.2. Non-Point Sources

No changes were made to Section 3.2 Non-Point Sources presented in the 2014 report.

3.3. Background

No changes were made to Section 3.3 Background presented in the 2014 report.

Upstream Flow:	Seasonal flows cited above
$CBOD_5$:	2.0 mg/L
Ammonia:	0.15 mg/L
DO:	85% saturation at the regulatory seasonal temperature

4. Linkage between Sources and Receiving Water

No changes needed to be made to the text presented in Section 4 introduction of the 2014 report. However, there were changes to Section 4.2 as specified below due to revised calculations of Maximum Assimilative Capacity (MAC).

4.1. Model Inputs

No changes were made to any of the model inputs as specified in Section 4.1. These remained as:

Hominy Creek:

BOD decay rate (**K_1**):	0.30/day
Reaeration Rate & Formula (**K_2**):	1.62 – 1.64/day
NBOD decay rate (**K_n**):	0.30/day
BOD settling rate (**K_s**):	0.03/day
Sediment Oxygen Demand (**SOD**):	0.070 $g/ft^2/day$

INCOG used a spreadsheet to develop the hydraulic equation coefficients and exponents for the LAQUAL model that gave a good fit to the field observations of widths and depths during the two surveys. The following exponential equations were used to calculate appropriate LAQUAL coefficients and exponents for velocity and depth of each reach:

$V = a*Q^b$ $D = c*Q^d + e$

Where: V = mean velocity (ft/sec)
Q = mean discharge (ft3/sec)
D = mean depth (ft)
a,b,c,d,e = constants

4.2. Maximum Assimilative Capacity

Because the WLA mass loadings changed for Sperry after adjusting the design flow from 0.25 MGD to 0.132 MGD, and after the slight adjustment of each season's headwater flow, the Maximum Assimilative Capacity (MAC) for each season was recalculated for each season. This was done by using the same MOS spreadsheets that had been jointly developed by ODEQ and INCOG for use with LAQUAL modeling. The revised MAC values presented in Table 1 below show the results of the remodeling of Sperry at 0.132 MGD. No new sensitivity analyses were run for the remodeling of Sperry because the sensitivity modeling used in the 2014 report was considered adequate as it represented greater mass loadings overall.

Table 1. Maximum Assimilative Capacity

Season	MAC Maximum Assimilative Capacity (lbs/day)
Summer (Jun–Oct)	7,433.56
Spring (Apr–May)	5,548.79
Winter (Nov–Mar)	5,469.18

Max. Assimil. Cap. = Max. Effluent load (lbs/d) + Headwater load (lbs/d) + SOD (lbs/d)

Where: Max. BODu Effluent Load = {max. [BOD5] to just meet DO target x 2.3 x 8.34 x MGD} + {max. [NH3] to just meet DO target x 4.33 x 8.34 x MGD}

Headwater BODu Load = {[BOD5] x 2.3 x 8.34 x MGD} + {[NH3] x 4.33 x 8.34 x MGD}

SOD Load = {SOD / Depth} x 35.316 x MGD x 8.34

5. Margin of Safety

No changes were made to the Margin of Safety (MOS) discussion from the 2014 WLA report. In the 2014 report, INCOG used two methods to calculate MOS. The formal approach that resulted in all mass load calculations (maximum assimilative capacity, reserve capacity, etc.) came from the MOS spreadsheets developed by ODEQ and INCOG for use with LAQUAL. In addition, INCOG performed a simple 20% increase in discharge loads from Skiatook and Sperry and compared model minimum DO concentrations to seasonal target DO. This extra MOS step was not done for remodeling because the mass loadings from Sperry were much less, with no change in Skiatook. Therefore, it was not necessary to show protection of the target DOs more than what is already shown using the MOS spreadsheets. Because Table 2 in the 2014 report was based upon Sperry at 0.25 MGD, it is no longer needed to assess MOS for Sperry at 0.132 MGD using the simplified MOS method.

6. Allocations

The revised seasonal allocation of loads calculated by the INCOG/ODEQ spreadsheets for Sperry at 0.132 MGD are shown in Table 2 below. Table 2 should replace Table 3 in the 2014 WLA report. The discussion in Section 6 of the 2014 WLA report is not changed, only the values in Table 2 below. Changes are due to remodeling Sperry at 0.132 MGD with a slightly higher headwater flow.

Table 2. Allocations

Season	LA Load Allocation (lb/day)	WLA Wasteload Allocation (lb/day)	MOS (20%) (lbs/day)	RC Reserved Capacity (lbs/day)
Summer	4,288.33	1,539.19	1,486.71	119.33
Spring	2,738.58	1,635.10	1,109.76	65.36
Winter	1,298.66	2,418.95	1,093.84	657.73

A convenient way to express the relationship of these various loads is:

TMDL = WLA + LA + MOS + RC
LA = Background + NPS
NPS = SOD / Depth converted to lbs/d

RC = MAC - WLA - LA - MOS
MAC = WLAmax + NPS + HWTR
Background = HWTR

7. Final Recommendations

This remodeling resulted in no changes to the Skiatook WLAs recommended in the 2014 WLA report. Remodeling of Sperry at their existing 208 Plan WLAs showed that there was adequate Reserve Capacity in Hominy Creek to keep Sperry at their present 208 Plan limits for 0.132 MGD.

Skiatook WWTF

Average Daily Design Effluent Flow (Q_e): 2.50 MGD
Summer (Jun - Oct): 15 mg/L CBOD5 and 8 mg/L NH3-N at 5 mg/L DO.
Spring (Apr - May): 17 mg/L CBOD5 and 8 mg/L NH3-N at 6 mg/L DO).
Winter (Nov - Mar): Secondary Limits (25 mg/L CBOD5 and 12 mg/L NH3-N at 2 mg/L DO).

Sperry WWTF – no change in 208 Plan Limits

Average Daily Design Effluent Flow (Q_e): 0.132 MGD
Summer (Jun - Oct): Secondary Limits (25 mg/L CBOD5 and 7.2 mg/L NH3-N) at 2 mg/L DO.
Spring (Apr - May): Secondary Limits (25 mg/L CBOD5 and 7.2 mg/L NH3-N) at 2 mg/L DO).
Winter (Nov - Mar): Secondary Limits (25 mg/L CBOD5 and 15.4 mg/L NH3-N at 2 mg/L DO).

8. Public Participation

This remodeling of Sperry for 0.132 MGD at their present 208 Plan limits has received technical review and approval by ODEQ. Because the 2014 WLA report had already addressed ODEQ comments and had received EPA approval, ODEQ requested that INCOG prepare this Addendum Report to supplement the information presented in the approved 2014 WLA report. ODEQ will prepare a Public Notice for the WLA changes for Skiatook.

The proposed limits will be implemented through the OPDES permit for Skiatook, which represents an adequate implementation of the wasteload allocation. The seasonal water quality models in this report show clearly that the recommended allocation of dissolved oxygen-demanding substances adequately addresses the stream's dissolved oxygen requirements. With the recommended limits in place, the stream will meet Oklahoma Water Quality Standards.

Both Skiatook and Sperry are required to submit monthly Discharge Monitoring Reports (DMR) to the Oklahoma Department of Environmental Quality. The DMRs will continue to ensure that the beneficial uses will be maintained in Hominy Creek.

9. Model Results

The model results were shown in this section. Figure 1 -3 indicated that DO Water Quality Standards were not violated with proposed WLA for Skiatook and current WLA for Sperry for all seasons. DO criteria are 6 mg/L for spring and winter and 5 mg/L for summer.

Figure 1. Simulated Spring DO Depletion in Hominy Creek

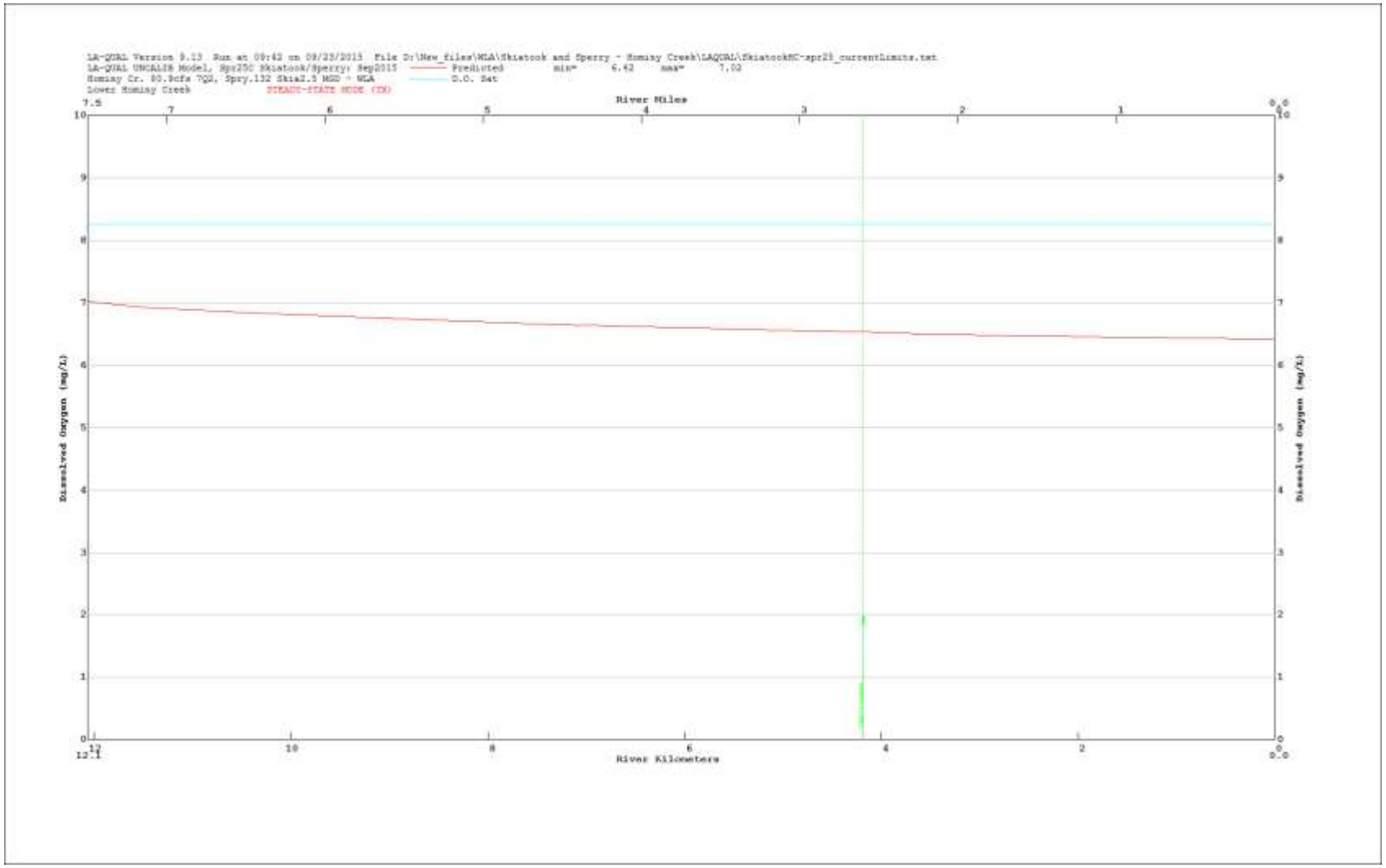

Figure 2. Simulated Summer DO Depletion in Hominy Creek

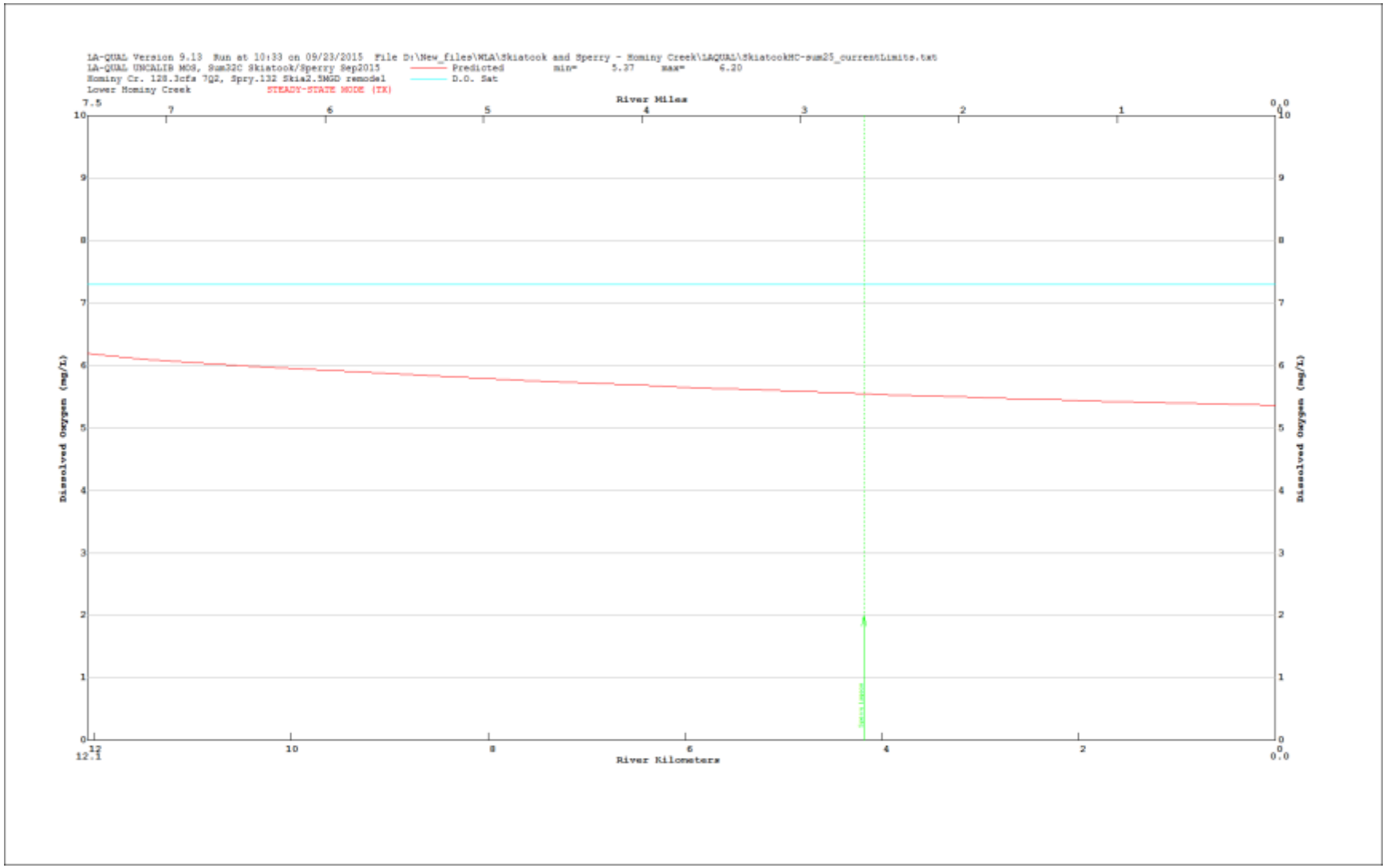

Figure 3. Simulated Winter DO Depletion in Hominy Creek