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Supplement #3 to Expert Witness Report
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January 11, 2019

In my Expert Report from July 9, 2018 and subsequent Supplement #1 (October 10) and #2 (December 2), I proposed a preliminary stormwater and wastewater management improvements and opinions on probable construction costs (OPCCs) for those improvements. Supplement #2 analyzed new information related to Drainage Studies completed by Ganem and Kelly Surveying Inc.

As described in Supplement #2, at the time of preparation of such supplement, not enough time was available for me to carefully review the information presented in the Drainage Studies and prepare an OPCC. The purpose of this supplement is to summarize the efforts to complete that task and present the OPCC to improve the conveyance system in order to adequately convey the stormwater flows to the outfalls in a way that floating materials can be properly controlled. I have also reviewed additional information from recently-produced discovery and depositions that further supports my opinions from my previous reports.

I. Methodology

1. Boundary limits for the analysis

The methodology that I used to develop the OPCC was to first evaluate in more detail each of the drainage studies prepared for Formosa to determine the scope that would be relevant to the purposes of the control of pellets and powders. Reports were analyzed for only those Outfalls draining areas where I am aware pellets or powders are mainly either manufactured, managed, handled, packaged, stored and/or shipped. Therefore, only reports for Outfalls 002, 006, 008 and 009 were considered within the scope of this analysis. Out of those reports, flood-prone infrastructure labeled in the drainage reports as "Problem Areas" were identified. However, "Problem Areas" were only identified and quantified for those areas where pellets and powders were either manufactured, managed, handled, packaged, stored or shipped. For example, for Outfall 006, only manufacturing areas including LLDPE, PE I, PP I, and their warehouses and shipping areas were included. However, Chlor-alkali, IEM, EDC, and office areas were excluded from the analysis.

2. Inventory of problematic infrastructure

Once the areas of analysis were delimited, infrastructure marked as a "Problem Area" in the drainage studies was identified and quantified. Inventories were categorized per type of infrastructure (concrete drainage ditch, grass ditch, pipe, culvert) per Outfall, and per manufacturing or service area. Details including materials, size, length, etc. as available and legible in the plans was collected.

3. Summary of problematic infrastructure

The inventory was summarized in a table to facilitate cost calculation maintaining the basic information necessary to still allow for an appropriate cost calculation. **Table 1** below summarizes the inventory of problem channels, pipes and culverts within the limits of the study for the purposes of pellets and powder control.

Table 1 - Problematic Infrastructure

OVERALL PROBLEMATIC AREAS				
Channels	Length (ft)	Vol (CY)		
Concrete Channels	38,234	19,829		
Grass Channel	6,018	5,949		
Pipes	Length (ft)	Vol (CY)		
RCP 2-30 in	482	129		
RCP 5-24 in	3,980	2653		
PVC 20 in	370	493		
PVC 2-18 in	100	133		
RCP 18 in	820	1093		
RCP 38 in	807	1076		
Culverts	Span	Vol (CY)	Barrels	Number of XS
PVC 10 in	11	15	1	1
RCP 12 in	30	200	5	5
RCP 15 in	60	160	3	2
RCP 18 in	30	560	17	14
RCP 21 in	60	160	2	2
RCP 24 in	60	240	3	3
RCP 24 in	30	120	4	3

4. Assumptions, limitations and Opinion of Probable Construction Cost (OPCC)

Once the inventory was completed, calculations related to volumes and types of materials and labor necessary to complete the infrastructure improvements had to be estimated. In order to do that, several assumptions were made. Below is the list of some of the major assumptions and limitations that were considered in order to formulate an opinion on the cost of construction.

- Problem areas were identified based on the results from the outfall drainage studies provided by Formosa. Thus, all the results in the OPCC rely on those studies, uncertainities associated with those studies, and the assumptions made for those studies, some of which may or may not be appropriate as I pointed out in Supplement #2 [Page 4]
- For OPCC calculation purposes I assumed that all the problem areas identified within the limits of this supplement would be addressed at the same time.
- The proposed improvements assume that the conveyance capacity of the problem areas is increased 100%, which would be able to handle twice as much flow that it currently does. The results from the Drainage Study are not conclusive as to what storm event Formosa's system currently is capable of conveying. The report does mentions that the system is not capable of conveying the 2-year storm, and "sometimes" not even the 1-year storm event. Per my Supplement #2 [page 6], it is my opinion that a 2-year storm event may be the bare minimum capacity for the purposes of pellets and powder control. I also state in my supplement that more typically, conveyance systems are designed for much larger than the 2-year event with 10-year or 25-year being more common design storms. Per Supplement #2, [page 6] the 1-year correspond to a 3.5 inch, whereas the 2-year storm correspond to a 4.6 inch event. If Formosa's conveyance system were generally capable of conveying the 1-year storm, for purposes of pellet and powder control the conveyance system will have to convey at least 1.1 inches more of rain, which in volumetric basis represents an upsizing of 31% of the drainage infrastructure's capacity. However, since the drainage study is not specific in terms of whether Formosa's conveyance system is in fact capable of conveying the 1-year storm event, I would recommend doubling the size of the conveyance system, which would allow for the conveyance of approximately a 7 inch storm event (and less for areas that do not currently convey the 1 year storm event), which corresponds to an approximately 5-year storm event, which is still a very reasonable, conservative basis for the design of a conveyance system. Therefore, based on the conclusions of the drainage studies prepared for Formosa, doubling the size of the conveyance system would in my opinion be reasonable and appropriate for controlling pellets and powder given the information available to me at this time.
- Location of existing underground utilities is unknown but assumed to be extensive based on Formosa operations. Cost of relocating or avoiding underground utilities cannot be estimated without knowing the location, so these unknown costs are incorporated into my determination of the contingency fee.

- Location and lengths of existing low crossings or needs to rise existing roads due to flooding issues at the facility. Costs of reconstruction and maintenance of those low crossings associated with lengths, widths, turnouts and tying into existing concrete cannot be determined at this point and are incorporated into my determination of the contingency fee.
- Effects of groundwater at the facility have not been considered. No geotechnical information has been made available to me. However, due to location, groundwater is likely to be shallow at the facility. Costs of dewatering operations during construction activities have not been considered
- Some of the information in the plans provided in the drainage studies was illegible. The information was read as possible and reasonable assumptions were made for those areas where legibility was not possible.
- In terms of impact area for construction, it was assumed that underground piping will be buried in trenches not to exceed 6 ft by 6 ft trenches. Culvert impacts are assumed to be 50 feet longitudinal from the area
- PVC piping would be replaced by RCP piping
- A 45% contingency is applied to the OPCC due to the uncertainties associated with underground utilities, likelihood of existence of low road crossings and need to replace those, groundwater impacts, other unknowns, and additional costs associated with engineering, etc. 45% is reasonable and in line with industry practices in my experience, especially given the large amount of unknown information available
- The costs assume that no clearing or grubbing of land would be needed as all the areas are currently developed

Some of the references utilized for the cost calculation include the following:

- Costs of Urban Stormwater Controls, Arvin Naanyanan and Robert Pitt, University of Alabama 2006
- Dallas Water Utilities and Dallas Public Works Construction Costs, 2018
- Cost of Urban Stormwater Controls, Heaney, Sample and Whright for the USEPA, 2002
- BMP Retrofit Program prepared by CALTRANS, 2012

Table 2 below summarizes the OPCC to upgrade the conveyance system at Formosa in those areas defined by this supplement to achieve adequate conveyance for the control of pellets and powders.

Table 2. OPCC

UPSIZING CONVEYANCE SYSTEM FOR WATER QUALITY PURPOSES				
Mobilization (assume 6 to allow for different teams and equipment to be mobilized)	EA	$3,500	6	$21,000
Unclassified Concrete Street excavation (channels and pipes)	CY	$25	26,861	$671,536
Haul/Dispose Excavated Concrete Materials (trench)	CY	$5	26,861	$134,307
Trench Safety and suport	LF	$3	45,884	$137,651
Remove and dispose of RCP	LF	$17	7,830	$133,110
Excavation/Embankment (concrete and grass channels upsized twice as big)	CY	$4	25,778	$95,377.22
Haul/Dispose of Excavated Material (concrete and grass channels upsized twice as big)	CY	$1	25,778	$28,355.39
Base course (crushed stone) and primer	CY	$20	39,658	$793,156.91
Trench (concrete Pouring on new trenches)	CY	$30	39,658	$1,189,735.37
Stabilization on new grass channels bermuda grass sodding (incl large main pipelines cov grass)	SY	$5	14,915	$74,573.61
5-foot manholes (10) - assuming one every 600 ft of pipe	EA	$7,115	10	$71,150
Cast iron heavy traffic channel grate (production areas -assume one fourth of concrete covers that need replacement)	LF	$215	1,640	$352,546
Pipe and culvert additional soil excavation to replace (assume 2 foot deep additional excavation pipes will be upsized two to four size up to achieve twice volumetric capacity)	CY	$4	3,480	$13,920
Pipe and culvert Replacement (pipes will be upsized two to four size up to achieve twice volumetric capacity)				
RCP 15	LF	$33	11	$363
RCP 18	LF	$36	150	$5,400
RCP 21	LF	$44	180	$7,830
RCP 27	LF	$70	937	$65,122
RCP 30	LF	$74	490	$36,260
RCP 36	LF	$98	4,280	$417,300
RCP 48	LF	$144	482	$69,408
RCP 54	LF	$216	807	$174,312
Connections to existing infrastructure (2% of piping cost)		2%		$15,798
Backfilling trenches made for laying pipes and culverts				
Bedding costs curshed stone/sand	LCY	$40	7,033	$277,785.07
Backfill (excavated material and added material as needed)	LCY	$3	7,033	$21,097.60
Class B Concrete (assuming long pipelines will remain covered with grass and no concrete)	CY	$172	4,251	$731,114.67
Remove and replace fence/protection rail bars	LF	$80	2,182	$174,560.00
6" thick reinforced concrete driveway for culverts (assume 50 feet impact area for culverts)	SF	$70	54,550	$3,818,500
Contingency (utility relocation, low road crossings, addressing groundwater effects, other unknowns as stated in assumptions and limitations & engineering, surveying, geotech costs 45%)	EA	45%		$4,289,071
Total Cost of Stormwater Conveyance System				**$13,820,340**

In summary, it is my opinion that $13,820,340 is the OPCC for Formosa to upgrade the conveyance system to properly address the control of pellets and powders at the facility. In the next section I provide a revised opinion on the overall cost of necessary improvements to achieve a comprehensive control of pellets and powders at the facility.

II. Additional Support for Opinions about Wastewater and Stormwater Discharges

My opinion from my July 9, 2018 report that "there have been and are still pellets and/or plastic materials discharges above trace amounts through Outfall 001" is further supported by the deposition testimony of Lisa Vitale, as representative for Freese & Nichols, Inc, that she and her colleagues have seen floating white pellets or small plastic pieces in Lavaca Bay and in the area near outfall 001 as part of her work on the receiving water monitoring program for Formosa's TPDES permit.

Ms. Vitale also testified that she told John Hyak of Formosa about these sightings as well as has sent him water samples with the pellets about five or six times, including at least one time prior to 2010. This, along with the June 2010 EPA Report I cited in my July Report, demonstrates to me that Formosa was aware of problems related to discharges of plastics from its facility since at least in 2010.

Finally, I have reviewed additional emails and documents provided only recently by Formosa related to drainage capacity concerns and the South Pond, which further support my opinions from my July Report that Formosa's stormwater system has ongoing deficiencies with respect to the control of pellets and powders, despite the controls Formosa has implemented to date. In particular, the South Pond project is specifically designed to address Formosa's pellet and drainage problems. In addition, these documents further demonstrate to me that Formosa has known about these problems for many years, prior to the 2016 NOVs from TCEQ.

III. Revisions to Opinions on Costs for Necessary Improvements

In my October 10, 2018 Supplemental Expert Report and subsequent Supplements #1 and #2, I provided my opinion on the costs for necessary improvements for Formosa's stormwater system infrastructure and source control. Based on new information from the 2013 drainage study and information I have learned from depositions, I make a few revisions to those opinions here.

a. Stormwater and Wastewater Controls
   I still believe the dollar amount of $1,678,821 (Expert Report p. 48) or $2,648,723 (Expert Report p. 47) would be the costs for necessary improvements to the stormwater

system, and $216,00 (Expert Report p. 50) are necessary for improvements to the wastewater system.

b. Source Controls

Source control is a necessary part of any stormwater or wastewater system. Although Formosa has been implementing source controls, it is my opinion that the controls installed to date are not sufficient to prevent pellets and powders from migrating from the manufacturing areas to other points across the facility. My expert report [p. 29 and 30] and paragraphs below provide the basis for my opinion.

While I have not developed independent opinions regarding the best source controls for Formosa's units, I am aware that Mike Rivet of Formosa has been working with all the production units to develop the best methods to limit loss of plastics from each of the production units. (Rivet Corporate Rep. deposition). While all production units are different, I understand that Mr. Rivet works independently on a regular basis (monthly) with representatives from each of them to help develop their own pellet source control projects. Mr. Rivet recognizes that HDPEI is currently the unit showing more progress in terms of understanding of the type of controls that they need. For the preparation of my Supplement #1, I reviewed the bids obtained by Formosa for pellet recovery projects at HDPEI. I have not compared the source controls recommended in any of these bids with other methods, but I have assumed that unit personnel, with Mr. Rivet's guidance, know what the needs are, and I considered that the source controls that were recommended to them were reasonable. Once I reviewed those bids, I took the lowest as the representative cost for a plastic recovery project for each of the pellet-manufacturing units at Formosa to calculate the [redacted] figure for source controls that I recommended in my first Supplement Report. Therefore, the [redacted] (from my first Supplement Report) remains a reasonable estimate of the cost necessary for source controls.

Additionally, I have reviewed excerpts from the deposition of Gary Patek, HDPE1 Manager, and several internal cost and approval forms for the source reduction project "700 silo transfer line and connections upgrade" to update 193 dresser couplings with flange type connections in the HDPE1 unit (Patek deposition, Deposition Exhibit 50). It is my understanding this is a Formosa project that is moving forward but has not been implemented yet. Formosa's rationale for the project states the need for this upgrade: "Whenever those transfer lines separate, it will cause pellet release to the ground. This is a source reduction project to reduce the accidental loss of pellets into the environment." I agree these flanges are a necessary part of source control at the facility and that the cost to upgrade 193 dresser couplings at the HDPE1 unit estimated in the B-1 Project Cost Estimation Form, [redacted] is a reasonable amount.

Patek testified in his deposition that even with this flange project, the HDPE1 unit is still working to get better at capturing pellets at the unit before they are released into the stormwater system (Patek deposition). Therefore, it is my opinion that additional costs are warranted at the units for pellet source control and recovery projects.

c. Conveyance System Capacity
   Per my Expert Report and Supplement #2, due to the nature of the treatment system at Formosa for pellets and powder being "end-of-pipe" and the ongoing problems with pellets and powder not being contained within the production units, it is my opinion the capacity of the conveyance system represents a major component in the efficacy of the control of pellets and powders at the facility. Therefore, upsizing the conveyance system is also necessary and the OPCC for that improvement is $13,820,340

Table 3. Summary Overall Costs

Improvements to drainage infrastructure to increase conveyance capacity	$13,820,340
Stormwater improvements	$1,678,821 or $2,648,723
Wastewater plant improvements	$216,000
Source Control	[redacted]
Total	[redacted]