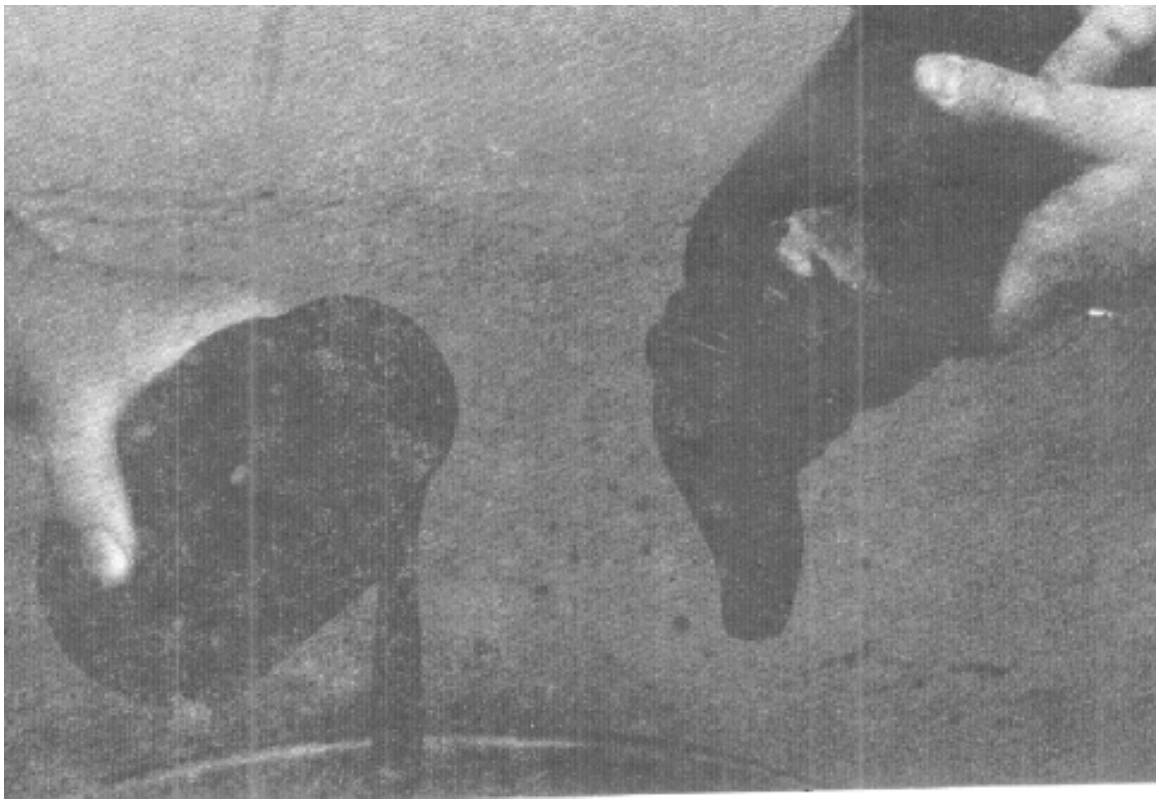
Part 1. Refinery Feedstock Switch

Introduction

This Project seeks to change the blends of crude oils and gas oils to be refined at the Chevron Richmond Refinery. The oil to be refined—the primary feedstock—is fundamental to the design of an oil refinery. The nature of Chevron's feedstock switch must be considered to evaluate potential impacts of the proposed Project on the environment.

Viscosity (resistance to flow) is an example of the differences between high and low quality oils. See Figure 1. One crude can flow like olive oil or motor oil while another flows like road tar or cold molasses. Various contaminants can be up to 20-5,000 times more concentrated in low quality crude than in high quality crude. This contamination of lower quality crude, and its poor distillation characteristics, make it harder to refine. Pollution results from processing larger amounts of contaminated, corrosive and flammable materials at high temperatures and pressures, and from burning more fuel to meet the hydrogen and energy requirements of this expanded processing.

Figure 1. Medium (left) and heavy (right) crude oils.



Photograph from California Division of Oil & Gas Publication TR28.

Comments on the Draft Environmental Impact Report (EIR) by CBE and others identified many impacts that could result from the switch to lower quality feedstock, such as increased severity of flaring, catastrophic risk, oil spill toxicity, air and water pollution, global warming and urban blight.[1] The comments sought limits on feedstock quality to avoid or lessen these impacts.[2]

The Final EIR (FEIR) dismisses these comments based on its conclusion that the Project will not result in any worsening of Refinery feedstock quality except for sulfur content.

This conclusion—that the Project will not significantly worsen the Refinery feedstock quality except for sulfur—is utterly unsupported by evidence. The FEIR fails to disclose key information about the design feedstock. Without this information, the full scope of impacts cannot be known. Yet, instead of disclosing this information, which the City has requested from Chevron, the FEIR relies on erroneous conclusions about the Project's feedstock and equipment design in a failed attempt to show that "dirtier" oil refining either will not occur or will be limited to sulfur. The FEIR does not adequately respond to the significant potential impacts of the Project.

Nondisclosure

The design specifications of a refinery's equipment and the quality of oils it can refine efficiently are interlocked.[3] Thus, feedstock quality *and* the design of proposed equipment must be known. Key design parameters include, among others, feedstock sulfur; acid; vanadium, selenium and mercury content, and (for crude) distillation yield.[4] Crude oil vendors specify these parameters quantitatively.[5] These parameters vary by oil source, so design specifications are needed for each key parameter. Refinery feedstock includes crude oil and imported gas oil, so data for both feedstock streams are necessary.

No proposed feedstock design specifications are included in the FEIR, except for a proposed equipment design capacity increase to 3% sulfur in crude oil. For gas oil, the FEIR says only that the Project would enable this feedstock to be "heavy" and higher in sulfur by an unspecified amount.[6] The current long-term feedstock quality—the baseline—is not quantified.[7] With the sole exception of post-Project sulfur in crude oil, the FEIR omits quantitative information on the baseline and proposed feedstock quality.

CBE requested this feedstock information in March 2007 and in our July 2007 comments on the DEIR.[8] The State Attorney General, and unions representing refinery workers also requested this information. On November 15, 2007, CBE submitted 47 data requests to the City and again requested this information.[9] These data requests, originally submitted to Chevron and the Energy Commission on October 16, 2007, specified feedstock and feedstock design data among other Project data. City staff has been asking Chevron to provide feedstock information by email since at least July 2007. On December 12, 2007, City staff wrote Chevron a letter that specifically identified CBE's November 15 requests, among other requests, and formally asked Chevron to respond to them.[10]

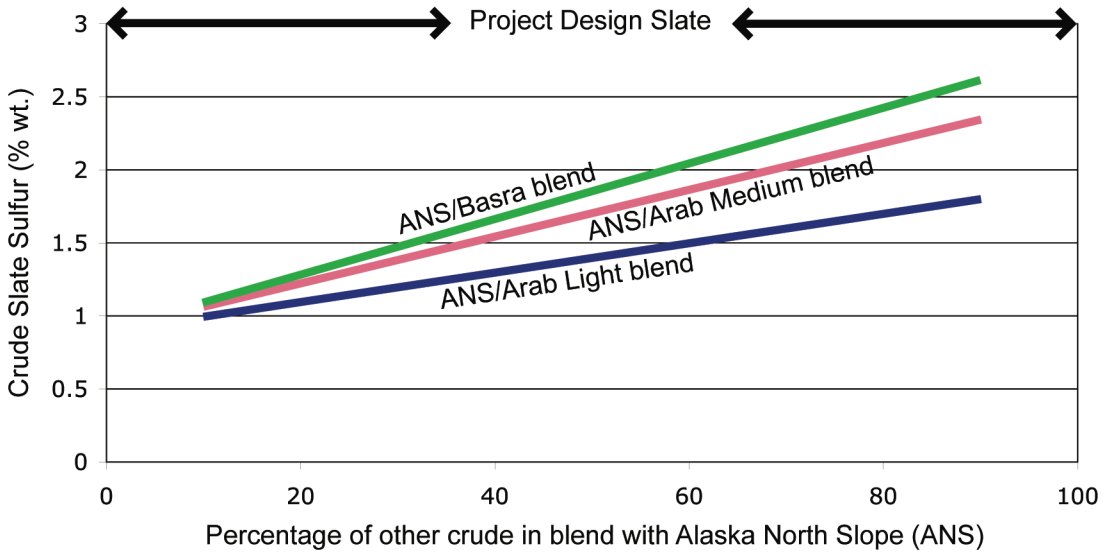
Since the EIR fails to include feedstock quality design specifications and baseline data, the FEIR fails to provide the information needed for environmental review.

Feedstock identification error

The FEIR erroneously asserts that post-Project feedstock is identified. The FEIR does not identify <u>any</u> source of the Refinery's imported gas oil feedstock. As to crude oil, the FEIR's assertion that post-Project feedstock will be only a "blend" of Alaska North Slope (ANS), Iraqi Basra, Arabian Light and Arabian Medium[11] is contradicted by the Project's design and the repeated feedstock switching that Chevron admits could continue to occur.

The Project is designed to run a lower quality crude slate than the FEIR identifies.[12] Based on its 3% sulfur design, for example, the Project would enable a higher sulfur slate than any blend of ANS with Basra, Arab Light, or Arab Medium, and would allow the Refinery to run 100% Iraqi Basra crude. See Figure 2.

Figure 2. Blends of crude oils identified by the FEIR v. Project design crude slate sulfur.



Based on design and sulfur content data on pages 2-8 and 3.9-2 of the FEIR.

The FEIR fails to disclose that its identification of oils to be refined is only what Chevron claims is "anticipated on the near term" based on "current business plans."[13] Chevron has made no commitment—even on the near term—to limit its feedstock to these crudes. On the contrary, Chevron states repeatedly that its future crude slate is unpredictable and will change when market conditions make that profitable.[14] The Refinery switched crude slates repeatedly in the past three decades:[15] the FEIR's assumption that it will not switch crude slates repeatedly over the next several decades during which Project equipment would be expected to operate[16] is unsupported and unreasonable.

Feedstock characterization error

Refining more contaminated and/or heavier (higher gravity[17]) oil increases pollution. The FEIR erroneously asserts that the proposed worsening of Refinery feedstock quality will be limited to sulfur because there is no strong or significant association between higher sulfur content and higher gravity,[18] or higher levels of other contaminants,[19] in crude oil. This assertion is disproved by longstanding scientific evidence and opinion holding that higher sulfur crude oils are likely to have higher gravity and higher levels of other contaminants.[20] Moreover, other readily available information that should have been presented, analyzed and discussed by the FEIR shows this conclusion is incorrect.

Hundreds of data for sulfur, metals, gravity and acidity (total acid number, or TAN) are available from assays of a wide variety of US and foreign crude oils.[21] Results from a statistical analysis of these data are shown in Table 1.

Table 1. Association of gravity, sulfur, metal, and acid content in crude oils.

Comparison	Samples	p value	Association	R-squared
Sulfur v. gravity (DOE Data)	8,978	<1.0E-300	*Highly significant*	0.40
Sulfur v. gravity (Assay Data)	411	7.4E-45	*Highly significant*	0.38
Vanadium v. sulfur (Assay Data)	349	1.1E-72	*Highly significant*	0.61
Vanadium v. gravity (Assay Data)	349	4.8E-31	*Highly significant*	0.32
Nickel v. sulfur (Assay Data)	349	4.2E-59	*Highly significant*	0.53
Nickel v. gravity (Assay Data)	349	1.6E-41	*Highly significant*	0.41
TAN v. sulfur (Assay Data)	310	2.4E-08	*Highly significant*	0.10
TAN v. gravity (Assay Data)	311	4.8E-33	*Highly significant*	0.37
Selenium v. sulfur (Se Assay data)	64	1.9E-05	*Highly significant*	0.26

Regression based on paired data from attached assays reported in attachments 1-G, 1-H and 1-I.

Increasing sulfur content is associated with increasing gravity in crude oils, and this association is highly significant, based on separate analyses of paired data from 8,978 samples in the DOE crude oil analysis summary database, and 411 samples in a second data compilation. (See the p values in the table above: the association is statistically significant when p is less than or equal to 0.01 (1E-02).) Similarly, increasing vanadium, nickel, acid and selenium are associated with increasing sulfur and gravity in crude, and these associations are highly significant, based on the data available for these analyses. Further, these parameters are strongly associated across a wide range of crude oils.

The FEIR's conclusion—that there is no strong or significant association between higher sulfur content, gravity, and concentrations of other contaminants—is incorrect. Thus, the FEIR's claim that impacts on feedstock quality must be limited to sulfur is erroneous.

Some oils have much higher proportions of certain contaminants to sulfur than the typical proportions in the majority of available oils. This variability is reflected in the statistical analysis above (for example the R-squared values in Table 1). It is also reflected in price discounts, which refiners can take advantage of by blending the cheaper, more

contaminated oils into their feedstock slates.[22] This variability requires that the Project design capacity be quantified for each parameter in crude (and gas oil) that may cause impacts. The FEIR notes this variability, but does not disclose these design criteria.

For example, the mercury content of Cupiaga crude (a Colombian oil) is three times that of Alaska North Slope (ANS) crude while the sulfur content of Cupiaga is only 9% of that of ANS. Similarly, the selenium content of Eocene crude is 55 times that of ANS while the sulfur content of Eocene is less than 5 times that of ANS. These examples are based on readily available assay data reported by Chevron and others.[23]

Based on these data, a 60/40 Eocene/ANS blend could stay within the proposed design capacity of 3% sulfur while the selenium content of the crude slate could increase to 1,680 ng/g. This selenium content (1,680 ppb) is 200% of the highest reported by any Bay Area refiner, and 1,870% of Chevron's slate when it was required to disclose data for investigations in the 1990s.[24] These investigations found a statistically significant increase in selenium discharge to the Bay with increasing crude slate content across four Bay Area refineries that did not have effective selenium treatment.[25] Based on these assay data and this statistical association, the 60/40 Eocene/ANS blend could, if realized, increase Chevron's selenium discharge to roughly *50 times* the current discharge rate.

Chevron reported the extremely high-selenium Eocene crude along with other crudes from Kuwait, Saudi Arabia, Iraq and elsewhere. The FEIR claims Chevron will refine some of these oils, but does not discuss Eocene crude, divulge its price, or disclose what involvement or plans Chevron may have regarding this crude oil. Further, although the potential for high-metals feedstock is more relevant for environmental analysis of the Project, the FEIR focuses only on examples of crude oils with unusually low selenium-to-sulfur ratios. See Table 2. In this context, the FEIR's assertion that "there is no reason to believe that replacing lower sulfur crudes from Alaska with higher-sulfur crudes from the Arab Gulf would increase selenium levels"[26] is both erroneous and misleading.

Table 2. Ratios of selenium to sulfur in 64 crude oils (ng/g Se divided by % wt. S).

	Selenium:sulfur ratio	Percent of oils above this ratio
90th Percentile of 64 oils	932	10 %
Median of 64 crude oils	254	50 %
10th Percentile of 64 oils	57	90 %
FEIR example (Basra, Iraq)	< 18	> 97 %
FEIR example (Arab Medium)	< 20	> 95 %
FEIR example (Arab Light)	< 26	> 94 %

Based on available data in Attachment 1-I and FEIR at 2-13, 3.9-2. Other oils besides the FEIR "examples" can be expected future feedstock as discussed elsewhere in this Section.

Equipment design error

The FEIR argues that there would be no worsening of feedstock quality other than sulfur because the increased processing that would be needed to refine lower-quality oil is beyond the Refinery's capacity, and the Project will not increase this capacity.[27] The fallacy of this argument is shocking: it asks us to forget that the current and proposed capacities of Refinery equipment are unknown or unverifiable because the FEIR has not disclosed this information.

Worse, the FEIR's attempt to support this fallacious argument runs afoul of CEQA.

Instead of considering actual process rates, the FEIR compares current and proposed Air District permit limits to support its erroneous assertion that the Project will not increase Refinery capacity to process lower quality oils.[28] These permit limits on the amounts of oil run through the processes are set higher than actual process throughputs. Chevron has repeatedly sought higher throughput limits, which have been granted without public review even when Air District staff believed Chevron had inflated its actual baseline.[29] By using these current permit limits instead of actual throughputs, the FEIR inflates the baseline, thus underestimating Project impacts. CEQA, however, requires that the baseline and therefore any increase in pollution be considered by assessing the *actual* environment at the time the CEQA review occurred.[30]

Actual throughput information that should have been presented, analyzed and discussed in the FEIR is shown in Table 3.[31] Considering these actual throughput rates reverses the FEIR's erroneous conclusion that processing of lower quality oils will not increase.

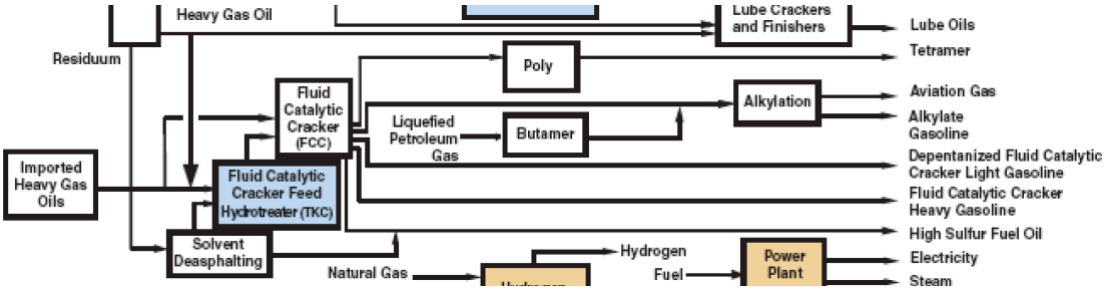
Table 3. Examples of errors in FEIR analysis of the average process rate baseline.

Barrels per day (BPD)	FEIR Analysis[a]	Actual Avg.[b]	Difference (%)
Catalytic Reforming units (CRUs)	71,300	42,410	28,890 (68%)
Fluid Catalytic Cracking Unit (FCC)	80,000	63,900	16,100 (25%)
Solvent Deasphalting Unit (SDA)	66,000	40,640	25,360 (62%)

a. FEIR assumes AQMD permit limits: See FEIR at 3.16a-4, 3.16a-5 and CBE-A Attachment 6.
b. Actual Avg: Average of highest 12 months reported in each of the 3 most recent 5-year NPDES reviews (except CRUs data from 1996-2000). See attachments 1-O, 1-P and 1-Q.

The FEIR claims there could be no expansion of gas oil processing by the interrelated hydrocracking and catalytic reforming units (the TKN/ISO and proposed Continuous Catalytic Reformer (CCR)) because, it asserts, Chevron will meet a CCR annual permit limit equal to the existing reformers' combined limits of 71,300 barrels per day (BPD).[32] The FEIR's assurance is misplaced. Actual annual average catalytic reforming throughputs reported for the Refinery total 42,410 BPD. See Table 3. At 71,300 BPD these throughputs would increase by 28,890 BPD or 68%.

Figure 3. Refinery heavy gas oil and residuum process flow diagram.



Detail from DEIR Figure 3-28. Renewal Project Changes to Refinery Block Flow Diagram.

As shown in Figure 3, the Fluid Catalytic Cracker (FCC) would be fed oil produced from residuum and heavy gas oils by the Solvent Deasphalting and TKC units, in addition to a direct feed of imported heavy gas oil.[33] The FEIR admits that average TKC throughput could increase to 80,000 BPD but insists this will not increase FCC throughput because the FCC's annual permit limit is already 80,000 BPD.[34] The FEIR is in error. Actual long-term average FCC throughput is approximately 63,900 BPD, as shown in Table 3. Receiving 80,000 BPD from the TKC would increase this FCC throughput by 16,100 BPD or 25%. The direct feed of imported heavy gas oil to the FCC shown in Figure 3 would further increase FCC throughput.

Solvent Deasphalting (SDA) could increase heavy feedstock processing by 25,360 BPD or 62% (Table 3; Figure 3), but this is not disclosed or analyzed in the FEIR at all.

The SDA processes the heaviest crude fraction (residuum) to produce oil that is fed to the TKC and FCC for cracking into lighter products. It uses a relatively heavier solvent to maximize this oil production,[35] no longer produces commercial asphalt,[36] and extracts so much oil from the residuum that the asphalt leftovers can be mixed into high-sulfur fuel oil. When the SDA process is used in this way, the gravity and especially the sulfur and metals content of the deasphalted oil can increase dramatically.[37] Contrary to Chevron's claim that the Project "will not provide the Richmond Refinery with the ability to process 'heavy' crude blends" because it lacks "a coker, or equivalent,"[38] the SDA allows the recovery of heavier oil for catalytic cracking feeds,[39] and in this scheme, is an alternative to a coker.[40] The FEIR does not disclose this information that contradicts its erroneous claim of inability to process heavier or more contaminated oils.

The actual capacities of existing and proposed equipment are undisclosed: they may be larger than proposed permit limits, which may be relaxed over the life of the Project. Indeed, proposed sulfur recovery capacity is 200-300% of reported throughput,[41] and the FEIR now claims that the huge proposed expansion of hydrogen production is designed for Refinery needs.[42] Expanded hydrogen production and sulfur recovery support the conversion and treatment of heavier, more contaminated, lower hydrogen oils.

Expanding these processes allows the Refinery to process more imported heavy gas oil and/or process heavier crude that produces more residuum from distillation and more gas oil from solvent deasphalting. It also allows more contaminated oils to be processed. The FEIR's claim that there would be no worsening of feedstock quality other than sulfur because the Refinery would continue to lack the capacity to process heavier or more contaminated blends of oils is unsupported by evidence and demonstrably incorrect.

Improper dismissal of comments

Because of the errors and omissions described above, each of the assertions that the FEIR relies upon to support its conclusion that Refinery feedstock quality will not worsen significantly except for sulfur is incorrect. The FEIR does not disclose information needed to assess the extent of the proposed feedstock switch and its potential impacts. Future Refinery feedstock sources are not known adequately to predict feedstock quality. A higher sulfur crude slate is likely to be higher in other pollutants and to require more pollution-intensive processing. The proposed Project would increase Refinery capacity for this processing of heavier oils that are higher in multiple contaminants.

Thus, the FEIR's conclusion that the Project will not significantly worsen Refinery feedstock quality except for sulfur is unsupported. Therefore, the FEIR's dismissal, based on this unsupported conclusion, of comments that identify potential impacts of the feedstock switch and seek feedstock limits to avoid or lessen these impacts, is improper.

False description

The FEIR describes the Project as an equipment replacement which includes a one-percent shift in crude sulfur content that is necessary to ensure the Refinery's ability to continue processing a similar oil supply.[43] This Project description does not describe the type, extent, or motivating factors of the potential feedstock switch accurately.

Instead of continuing to process a similar oil supply, the Project could enable a switch to oil sands and extra-heavy crude. California refineries are a target market for at least some of these oils. See Figure 4 below. Chevron boasts of using "hydroprocessing and coking processes" in Venezuela "to upgrade extra-heavy crude from Venezuela's 'Orinoco Belt' to a more fungible lighter crude" in its Hamaca joint venture.[44] This partially processed Hamaca crude is 1.55% sulfur, and several synthetic crude oils produced from Canadian oil sands have 2.55 to 2.91% sulfur.[45] The Project's proposed capacity of 3% sulfur would allow the Refinery to process oils with this sulfur content. The increase in Refinery capacity for heavier feedstock shown above would further facilitate this potential shift to use of extra-heavy crude and oil sands. Indeed, a special section in Chevron's 2006 Annual Report asserts "we are integrating our downstream refining technologies into our upstream operations to develop extra-heavy oil and oil sands."[46] The FEIR fails to disclose this readily available information.[47]

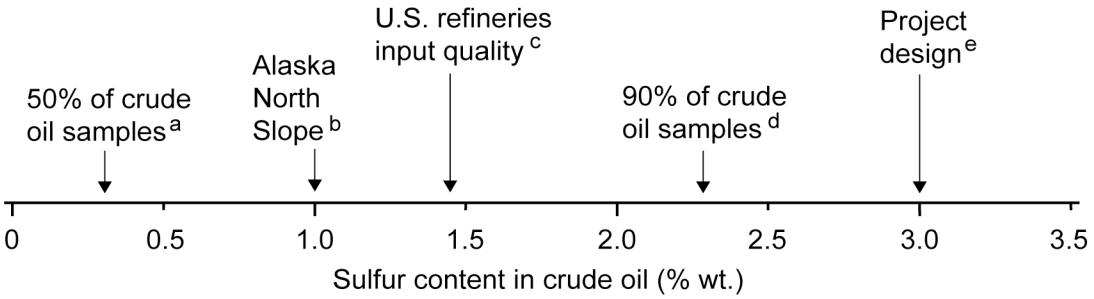
Figure 4. Pipeline and pipeline-to-ship routes for tar sand-derived Canadian oils.

From "Oil Sands Update: Special Report" in Oil & Gas Journal, July 9, 2007.

Oil sands and extra-heavy oil are unconventional hydrocarbons, a new and different feedstock than the Refinery's current conventional crude slate, with different and greater impacts.[48] The FEIR does not disclose this potential for a different type of feedstock.

Further, the FEIR's description of a "similar" crude slate with 1% more sulfur does not describe the extent of this feedstock quality switch. The post-Project slate could have twice as much sulfur as the U.S. refinery input, three times as much as the Refinery's previous ANS-dominated slate, ten times as much as 50% of the crude samples from available assays, and more sulfur than 90% of these 9,390 crude samples. See Figure 5.

Figure 5. Comparative scale of proposed feedstock sulfur increase.



a. 50% of 9,390 crude samples are below this level (data from attachments 1-G and 1-H).
b. ANS (Assay data, attached) approximates the Richmond Refinery slate in the 1990s.
c. U.S. refineries input quality in 2001, US EIA presentation, World Fuels Conf., Sept. 2002.
d. 90% of 9,390 crude samples are below this level (data from attachments 1-G and 1-H).
e. Proposed post-Project Richmond Refinery design for crude sulfur content.

This extreme contamination of the proposed feedstock is not disclosed in the FEIR.

Finally, the reason for the feedstock switch is not described accurately. The FEIR repeatedly implies that the switch to higher-sulfur oils is necessary to ensure an adequate supply of feedstock for the Refinery to continue producing fuels.[49] This implication is misleading. Most crude oils—and the nationwide U.S. refining input—are much lower in sulfur than the proposed Project design slate, based on the large available data set summarized in Figure 5. Better quality oil is available, but poor quality oil is cheaper,[50] and price is a factor in Chevron's choice of feedstock.[51] Again, the FEIR fails to provide this readily available information.

The Project as proposed could switch to extremely contaminated feedstock, possibly including extra-heavy oil and oil sands, and would enable such low-cost, high-pollution feedstock despite the availability of better quality oils. By describing it as an equipment replacement that only shifts to similar oils with one-percent more sulfur because better quality oil is unavailable, the FEIR provides a false description of the Project.

The FEIR is fundamentally deficient, through error and omission, as described above, and precludes the public the opportunity to meaningfully review and comment on the proposed Project.

Respectfully Submitted February 20, 2008.
Greg Karras, Senior Scientist
Adrienne Bloch, Senior Attorney

Section 1 notes, references and identification of attachments.

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[1] See other sections of this comment: This section addresses the extent of the feedstock switch.
[2] See e.g., FEIR at CBE-A, page 19 and 3.12 (Public Hearing Transcript), pages 21 and 63.
[3] Compare FEIR at 2-15 with the nearly identical text emailed July 18, 2007 by Robert Chamberlin of Chevron to City Planning staff and consultants, Chevron Renewal Project Response to Key Public Comment Areas RTC 7-18-07 Attachment at page 10 ("crude slate must match processing capability of units downstream of initial distillation … Refinery configuration established with a certain crude oil composition in mind … The Refinery is designed with a fair amount of specificity … Processing oil with drastically different chemical and physical

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composition would not be feasible while continuing to meet air and water emissions limits"); and see FEIR at 3.16a-7 ("The City concurs with [CBE] that there is a feedstock-process equipment interdependence at a refinery").

[4] See e.g., DOE, 2002. Strategic Petroleum Reserve Crude Oil Assay Manual (Attachment 1-A); Excerpted chapters from Petroleum Refining Processes by Speight and Ozum and Petroleum Refining Technology and Economics by Gary and Handwerk (Attachment 1-B); and Wilhelm and Spitz, 2002 (Attachment 1-C). See also CEC, 2006 as cited by the FEIR at 2-17.

[5] See http://crudemarketing.chevron.com and the "Assay Data" attachment described below.

[6] See e.g., FEIR at page 3.16a-4; and DEIR at pages 6-3 and 6-4.

[7] The EIR provides an inflated "baseline" for sulfur, as detailed elsewhere in these comments.

[8] See FEIR at CBE Exhibit A, Attachment 16, pages 4 and 5.

[9] The City acknowledges CBE's November 15, 2007 Supplemental Comments on the DEIR and the data requests attached thereto, as shown by its correspondence referenced in note 10 below.

[10] December 12, 2007 letter from City Manager Bill Lindsay to Dean O'Hair, Chevron. See also February 15, 2007 [sic; received by CBE 2/19/08] letter from Elena Saxonhouse on behalf of the City to Greg Karras, CBE ("City has not received a response from Chevron regarding CBE's supplemental comments or the attachment thereto").

[11] This inaccurate statement is made repeatedly, but see FEIR at 2-8, 2-9 and esp.2-13.

[12] See also FEIR at 2-13 (with the proposed 3% sulfur design the current ANS slate could be replaced but the new crudes are not named except for two "reasonably foreseeable" examples).

[13] Compare FEIR at 2.8 to 2.9 with nearly identical text regarding past, present and future crude slates and gravity in November 6, 2007 Chevron Response to Comments on Crude Oil Slate from Piersante at 1 and 3; and FEIR at 2-13 ("reasonably foreseeable that Chevron would run a crude slate similar to that which is currently processed at the Refinery—but in a mixture that has higher sulfur levels") with July 18, 2007 Renewal Project Response to Key Public Comment Areas from Chamberlin at 8-9 ("current business plans include running a similar crude slate as to what is currently processed at the Refinery. Hence, an increased in heavier crude slate is not anticipated in the near term … current business plans include running a similar crude slate as to what is currently processed at the Refinery—but in a mixture that has higher sulfur levels").

[14] See e.g., the excerpt in Attachment 1-D from Chevron's response to comments on BAAQMD Application 3802 ("because market conditions and refinery operating conditions change, it is not possible to predict in advance which high-sulfur crudes will be processed"); and Attachment 1-E, Chevron's response to a RWQCB request for data on selenium ("should the price for Alaska North Slope dramatically increase due to excessive demand or limited availability it may be economical to process different crudes with a higher selenium content").

[15] The FEIR admits this repeated crude slate switching at 2-8.

[16] The FEIR admits this Project equipment operational life at 3.16a-1.

[17] The gravity of crude oil, quantified as mass-per-unit-volume, specific gravity or ºAPI, is a key characteristic that is related to its distillation yield. As compared with "light" crude, "heavy" crude requires more processing to make the same amounts of gasoline, diesel and jet fuel. This additional processing creates pollutants. Heavier crude oils also tend to be more contaminated.

[18] FEIR at 2-7 through 2-14, especially the erroneous statement on page 2-11 ("content of sulfur compounds in crude oil is independent of its specific gravity"); and FEIR at 3.16a-5 ("there is not a direct correlation between sulfur content and heavier crude").

[19] FEIR at 2-7 through 2-14, especially the erroneous statements on page 2-12 ("concentration of metals in any single crude delivery is not related to the presence and concentration of other

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chemical constituents such as sulfur") and page 2-13 ("no correlation between selenium levels and sulfur content or the heaviness of the crude").

[20] See e.g., Speight and Ozum at pages 76 and 77 in Attachment 1-B ("heavy oils and residua contain relatively high proportions of metals … correlations exist between the density [API gravity] and sulfur content"); Branthaver, 1987. *In* Metal Complexes in Fossil Fuels, Filby and Branthaver, Eds., at page 191 in Attachment 1-F ("heavy crudes are characterized by low API gravity [<20], high asphaltene content, and relatively high concentrations of sulfur, nitrogen, and oxygen-containing compounds … heavy crudes usually contain substantial concentrations of vanadium and nickel complexes"); and Reynolds et al. (Chevron Research Company), 1987 at 205 in Attachment 1-F ("heavy crudes contain high metals levels").

[21] These data should have been provided in the DEIR. Instead, CBE compiled them in the course of responding to an informal request by the State Attorney General. See "Attachment 1-G. DOE Data," "Attachment 1-H. Assay Data" and "Attachment 1-I. Se Assays."

[22] See e.g. Wilhelm and Spitz, 2002 at 5 (attached hereto). Note also that CBE raised this issue in a comment on the DEIR (FEIR Comment Letter CBE-A, Comment 7), but the FEIR failed to respond to this issue in any substantive manner (FEIR at page 3.16a-10).

[23] BP (4/16/99 and 6/3/02) and Chevron (2000) sample assays in Attachment 1-H; and additional Chevron data for Eocene crude as reported on page 3.9-2 of the FEIR. See also the mercury data attached hereto in Wilhelm et al. 2007 (Attachment 1-J).

[24] Attachment 1-K. CBE, 1994. Dirty Crude. The first oil industry-wide analysis of selenium discharge trends impacting San Francisco Bay. See e.g., Table 3.

[25] Specifically, $y = 0.0475x - 2.74$ where y is discharge (mg/Bbl) and x is oil content (ppb), $p = 0.002$, R-squared = 0.99 based on CBE 1994, attached; see esp. pages 11-16 and Table 3.

[26] FEIR at 2-13. See also FEIR at 3.9-4, 3.9-5 (FEIR and RWQCB relied on the false assertions that "the crude sources the Refinery will use in the future would have low selenium content similar to those crudes used today" and that crude selenium and sulfur are not correlated).

[27] FEIR at 2-3, 2-6, 2-8, 2-10, 2-11, 2-14, 2-15, 3.16a-2 to 3.16a-7, 3.16b-2 and 3.16b-3.

[28] FEIR at 3.16a-3, 3.16a-4 and 3.16a-5. Note that the FEIR commits this error despite CBE's explicit warning in comments on the DEIR. FEIR at CBE-A page 8 and (non)response at 3.16a-8.

[29] See e.g., Attachment 1-L, excerpts from BAAQMD App. 19515 Evaluation Report (prior to major project "Chevron dramatically increased the feedrate to the FCCU and in doing so received a baseline permit condition … The baseline that was agreed to was extremely high"); and Attachment 1-M, excerpts from App. 9163 Chevron 3/24/93 Modifications to Data Forms (seeking increased SDA throughput limits based on upward revision of original process data because "plant designers are conservative, and actual hydraulic limits often exceed what the designers are willing to guarantee").

[30] See Attachment 1-N. Court of Appeal Decision in CBE et al. v. SCAQMD. B19350 (LA Cnty. Super. Ct. BS 091275). Filed 12/18/07. Cert. 1/16/08.

[31] Actual averages in Table 3 are based on actual average throughputs of Richmond Refinery processes, released by the S.F. Bay Regional Water Quality Control Board during the three most recent five-year reviews of Chevron's Bay discharge permit. See attachments 1-O, 1-P and 1-Q. CRU throughputs are reported separately from other processes only in the RWQCB public data release for 1996-2000 (Attachment 1-P).

[32] FEIR at 3.16a-5.

[33] See also FEIR at CBE-A page 3, and 3.16a-4 (TKC product normally fed directly to the FCC).

[34] FEIR at 3.16a-2 through 3.16a-4.

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[35] See Chevron's 5/28/92 Permit Application, BAAQMD App. 009163 ("This project will also the plant to use a heavier solvent to extract more oil from residuum. The oil extracted will then be cracked into lighter products … the refinery will produce less high sulfur fuel oil.")
[36] See NPDES throughput data, "Thpt 2001" and "Thpt 2006," attached.
[37] Attachment 1-R. Meyers, 1986. Handbook of Petroleum Refining Processes. ISBN 0-07-041763-6. See esp. pages 8-21, 8-34 and 8-37.
[38] November 6, 2007 Chevron Response to Comments on Crude Oil Slate from Piersante at 3.
[39] DEIR Figure 3-28; and Attachment 1-R. Myers, 1986 at 8-20 and 8-21.
[40] "[S]olvent deasphalting (when employed for feedstock preparation to catalytic cracking units) may be considered a competitor to vacuum distillation, visbreaking, and coking." Attachment 1-S. Speight, 1991. The Chemistry and Technology of Petroleum 2nd ed at page 646.
[41] Proposed capacities of SRUs 1, 2 and 3 total 445,300 long tons/year based on the most recent publicly verifiable BAAQMD Permit App. Data (Form G submissions dated 8/16/06, 8/16/06 and 6/29/06 in FEIR at CBE-A Att. 2). Unconfirmed revised proposed capacities total 310,250 LT/yr (revised Source List, FEIR Technical App.). The most recent 12 month throughputs reported total 151,911 LT/yr (revised App. D.2 and Revised Emission Assumptions, FEIR Technical App.)
[42] See FEIR at 2-6.
[43] See FEIR at 2-8, 2-13 and 3-16b-3; DEIR at 1-1, 3-4, 3-26 and 6-11.
[44] See http://crudemarketing.chevron.com/overview.asp?hamaca as of 2/4/08.
[45] See Hamaca and, e.g., Albian Heavy Synthetic, Albian Residual Blend and Christina Synbit in "Assay Data" compilation (attached); and see e.g., Athabasca in Attachment 14 to CBE-A.
[46] Chevron 2006 Annual Report to Shareholders at 9.
[47] See FEIR at CBE-A pages 10, 11, 15-17; (non)responses A-7 and A-11 at 3.16a-10, 3.16a-11.
[48] See Chevron 2006 Annual Report to Shareholders at 9 and FEIR at Att. 11 to CBE-A (oil sands and extra heavy crude are unconventional hydrocarbons with new and different impacts); and FEIR at 2-13 (ANS currently processed); and CBE, 1994 (attached) (ANS processed in 1990s).
[49] Although similar text appears repeatedly in the FEIR, see 2-8 ("Chevron anticipates that the amount of sulfur in the mix of the available intermediate and light crude oils will continue to increase"); and DEIR at 6-11 ("continued importation of sweet crude may not be feasible because future availability of sweet crude is in question").
[50] See e.g. Attachment 1-C. Wilhelm and Spitz, 2002 at 5; US EIA, September 2002. Refinery Challenges: Changing Crude Oil Quality & Product Specifications. Presentation to World Fuels Conference, Washington, D.C., by Joanne Shore; and FEIR at CBE-A page 10 (data suggest a 50-year supply of sweet crude for Refinery available and that feedstock cost is the main issue), and (non)response at 3.16a-10.
[51] Attachment 1-D. App. 3802; Attachment 1-E, Chevron Response to RWQCB; and FEIR at CBE-A page 10 and (non)response at 3.16a-10.