PETROLEUM REFINING LISTING DETERMINATION

PROPOSED RULE RESPONSE TO COMMENT DOCUMENT

Part II

June 1998

U.S. Environmental Protection Agency
Office of Solid Waste
401 M Street, SW
Washington, DC 20460

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III.   HEALTH AND RISK ASSESSMENTS

A.   TRIMETHYLBENZENE: The Agency requested comments on the appropriateness of the provisional RfD and the availability of any additional data on the toxicity of 1,3,5-trimethylbenzene. The Agency also requested comments on the appropriateness of using a surrogate (SAR) analysis for constituents with no health effects data, and requested any toxicity data on these constituents.

No specific comments were submitted in response to these requests.

B.   PAH POTENCY ESTIMATION: The Agency requested comment on the uncertainties and limitations of two methods for estimating the potency of PAHs.

Comment 1: The inclusion of 7,12-dimethylbenz(a)anthracene and 3-methyl cholanthrene in the CSO risk assessment significantly overestimates the risk posed by PAH-containing wastes. Inclusion of these compounds in the risk analysis is inappropriate because, even if these compounds are present in the waste as generated, they would be chemically and biologically degraded so quickly in the environment that they are unlikely to reach a receptor and contribute to the risk. Because 7,12-dimethylbenz(a)anthracene and 3-methyl cholanthrene have high cancer slope factors; their inclusion in the risk analysis causes the risk to be substantially overestimated. (EEI, 00026)

Response: EPA agrees that biodegradation may be a significant removal process for PAHs and should be considered in analysis of PAH fate and transport. While biodegradation of PAHs within land treatment units was considered in the analysis for the proposed listing, biodegradation that may occur during transport and at the receptor location was not. Accordingly, in response to comments, the non-groundwater risk analysis was been expanded to include biodegradation of PAHs outside the LTUs for the waste streams of concern. Detailed results of this analysis were provided in the Supplemental Background Document; NonGroundwater Pathway Risk Assessment; Petroleum Process Waste Listing Determination in the docket for the April 8, 1997, NODA. While the half-life of 7,12-dimethylbenz(a)anthracene is relatively short at 28 days (Park et al., 1990), the half life for 3-methyl cholanthrene is reported to be from 1.67 to 3.84 years (Howard et al., 1991). The following table (Table III.B-1) presents the data available for estimating the biodegradation of PAH in soil. These rates are dependent on the soil type, soil biota, and meteorologic parameters at the site. EPA has chosen to use the lowest value for this parameter in order to assure that biodegradation is not over-estimated when soil and meteorologic conditions are not ideal. However, biodegradation rates were included as variable parameters in the quantitative uncertainty analysis conducted in support of this listing decision. The inclusion of biodegradation did not affect the listing decision. In addition, a risk level of 1E-05 is estimated at the 90th percentile for the home gardener living near a petroleum refinery where CSO sediment is disposed in an on-site LTU even if 7,12-dimethylbenz(a)anthracene and 3-methylcholanthrene are removed from consideration entirely.

Table III.B-1. Biodegradation Rates of PAHs								
Constituent	Benz(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	7,12-Dimethyl benz (a)anthracene	Indeno (1,2,3-cd) pyrene	3-Methyl- cholanthrene
Biodegradation Rates (1/yr)	2.48	4.44	1.20	0.278	46.0	1.75	12.6	0.422	0.415
	1.56	1.11	0.861	0.118	1.13	0.701	9.04	0.347	0.181
	0.969	1.10	0.858	0.0797	0.771	0.602			
	0.372	0.819	0.703		0.682	0.269			
		0.607	0.415		0.654				
		0.478			0.253				
		0.307							

Comment 2: The commenter is concerned about the analytical methodology used to identify 7,12-dimethylbenz(a)anthracene and 3-methyl cholanthrene, which are extremely difficult to identify conclusively. (EEI, 00026)

Response: These two compounds are appropriately included in the risk assessment analysis because they were identified as waste stream constituents in the waste sampling and analysis. The sampling and analysis protocol is provided in the Quality Assurance Project Plan for Record Sampling Under the 1992-1996 Petroleum Refining Listing Determination and Industry Study, September 22, 1993, Docket # F-95-PRLP-S0011.

The CSO sediment samples were analyzed using EPA approved methodology outlined in SW-846, 3rd edition and as documented in the September 1993, QAPjP, site-specific sampling and analysis plans, and analytical data reports. Each sample was extracted according to Method 3550A (sonication) followed by Gel-Permeation Chromatography (GPC) cleanup according to Method 3640B. Extracts were then analyzed with GC/MS instrumentation according to Method 8270B. Due to the large number of semivolatile target analytes requested and potential problems associated with reference standard compatibility, the contract laboratory performed three separate initial calibration curves for all samples associated with the petroleum refining listing, one for the majority of target analytes specified in Method 8270, and two additional curves using the industry specific, non-routine target analytes. Therefore, 7,12-dimethylbenz(a)anthracene and 3-methyl cholanthrene were calibrated to develop a second curve using a mixture of seven similar PAH compounds in the concentration range of 20 to 160 ppb. The laboratory was successful in meeting all method-specific instrument calibration, extraction efficiency, and analytical precision and accuracy requirements for the two samples in which the PAH compounds in question were detected. In addition, the validity of each calibration curve was evaluated with the analysis of a laboratory control standard containing representative target analytes prepared independently of the calibration standards. The reported concentrations of 7,12-dimethylbenz(a)anthracene and 3-methyl cholanthrene were based on multiple sample analyses due to the number of analytical

dilutions that were required to quantitate all target analytes within the established linear calibration range as described in the following table (Table III.B-2). The diluted sample concentrations are considered the most valid since all detected target analytes were quantitated within the established linear calibration range. Given that these compounds were detected in all analyses attempted and the acceptable extraction efficiency as demonstrated by favorable surrogate recovery and compliant internal standard area abundance values, the EPA is confident that all PAH concentrations reported for the CSO sample analysis are valid and representative.

Table III.B-2. Semivolatile Surrogate Percent Recovery and Detected Sample Concentrations						
Sample ID	S1 (2FP)	S2 (PHL)	S3 (NBZ)	S4 (FBP)	S5 (TBP)	S6 (TPH)
R9-SO-01 [1]	65	84	77	84	43	* 166
Detected Concentration of 7,12-Dimethylbenz(a)anthracene (ppb)						950,000 E
R9-SO-01 DL [1]	D	D	D	D	D	D
Detected Concentration of 7,12-Dimethylbenz(a)anthracene (ppb)						1,200,000
R1B-SO-01 [1]	* 9	38	* 122	94	26	77
Detected Concentration of 3-Methyl cholanthrene (ppb)						27,000
R1B-SO-01 DL [1]	D	D	D	D	D	D
Detected Concentration of 3-Methylcholanthrene (ppb)						27,000 J

<u>QC Limits</u>

S1 (2FP)	= 2-Fluorophenol	25-121
S2 (PHL)	= Phenol-d_6	24-113
S3 (NBZ)	= Nitrobenzene-d_5	23-120
S4 (FBP)	= 2-Fluorobiphenyl	30-115
S5 (TBP)	= 2,4,6-Tribromophenol	19-122
S6 (TPH)	= Terphenyl-d_{14}	18-137

1   All internal standard areas were within ± 50% of the upper and lower standard area limits.
D   Surrogate diluted to concentration less than detection limit.
*   Values outside the recommended QC limits.
DL   Sample was diluted to quantify target analytes within the range of the calibration curve.
E   Concentration exceeds the calibration linear range.
J   Concentration is estimated because analyte was detected at an amount less than the amount present in the lowest calibration standard.

C.   PLAUSIBLE MANAGEMENT: The Agency requested comments on its choice of plausible management scenarios and the possibility of using alternative scenarios.

Comment 1: The commenters support the common sense approach to base listing determinations on plausible management practices. (Valero, 00051; Mobil, 00033)

Response: The Agency acknowledges the commenters' support.

Comment 2: Waste management practices (e.g., surface impoundments, onsite cover for landfill or land treatment units, use as road bed material, storage in a pile) potentially posing substantial human health and environmental risks were not evaluated by the agency. (EDF, 00036, Section II.A; ETC, 00038)

Response: The commenter cited waste-specific examples of its concern regarding the Agency's choice of management scenarios of concern in the context of its specific comments on the individual wastes. EPA's detailed responses to these concerns are provided in Section IV on a waste-by-waste basis. The Agency's decisions not to model certain scenarios in its risk assessment were sound for the reasons discussed in these responses. See IV.F.2, Comment 1 for a discussion of storage piles for off-specification product and fines from thermal treatment. See IV.H.2, Comment 1 for a discussion of surface impoundments associated with HF alkylation units. See IV.E.2, Comment 1 for a discussion of surface impoundments associated with spent caustics. See IV.A.5, Comment 2 for a discussion of the use of crude oil tank sediment as landfill cover. See IV.B.2, Comment 4 for a discussion of the use of CSO as onsite road bed material.

D.   BIODEGRADATION: The EPA requested comments on the benzene biodegradation rates determined by the Agency; and requested submission of any biodegradation data that can be used for nationwide modeling analyses.

Comment 1: The commenter believes that the biodegradation of benzene should be considered to estimate the potential risks from Subtitle D landfilling of spent hydrotreating catalyst, spent hydrorefining catalyst, and crude oil storage tank bottom sediment. The commenter further contends that if biodegradation had been considered, the estimated risks from such management of those residuals would have been substantially lower and recommended that EPA should give significant weight to biodegradation as an additional factor in the final listing decisions for the residuals of concern. This belief is supported by the following points:

1)   There is adequate evidence in the recent literature that indicate both anaerobic and aerobic biodegradation processes play key roles in limiting the groundwater transport of benzene.

2)   Multiple independent research efforts have confirmed the anaerobic biodegradability of benzene.

3) Documentation of both lab and field studies show aerobic and anaerobic biodegradation processes in groundwater act to substantially reduce the travel distances of plumes containing BTEX compounds.

4) Field studies of intrinsic bioremediation provide further conclusive evidence of the limited transport of BTEX compounds in groundwater.

5) The anaerobic biodegradability of the TEX compounds has been evaluated, and it has been documented that the anaerobic biodegradation of these compounds facilitates the eventual aerobic biodegradation of benzene at the plume periphery.

6) The TCLP leachate values for BTEX for the refinery residuals of interest are comparable to BTEX concentrations commonly measured at fuel release field sites. Therefore, the commenter believes it is reasonable to extrapolate from the results of field fuel BTEX studies to the residuals of interest.

7) Field studies of 100% oily materials show that the process of biodegradation will limit the plume size to typically less than 100 meters.

The commenter provided a table of data from a collection of peer-reviewed and other published literature that characterized anaerobic biodegradation of benzene at more than 12 different sites across the U.S. and Europe. The values for biodegradation rates range from 0.0003 to 0.02 (1/day). Although these data were not generated using the federally-approved protocol under the Toxic Substances Control Act (TSCA), the commenter asserts that the methodology used to determine these values is sufficient to allow the acceptance of the data and conclusions which are presented in peer-reviewed journals. The commenter believes that these data should be accepted by the Agency as comparable to data generated by the TSCA protocol.

Furthermore, the commenter believes that the specific requirement of the TSCA protocol to provide samples from at least six sites is unnecessary to characterize the range which most biodegradation of benzene occurs. The commenter requested that the Agency review the TSCA protocol and the data submitted by the commenter. (API, 00046; Shell 00047; Sun, 00034)

Response: EPA conducted an evaluation of all submitted data. The documented anaerobic biodegradation studies of benzene suggest that in-situ anaerobic biodegradation of benzene rates may be strongly dependent on site-specific conditions *(e.g.*, availability of electron acceptors, availability of nutrients, temperature, etc.). In response to all seven points listed in the comment above, the necessary conditions for anaerobic benzene biodegradation are poorly understood. The absence of biodegradation can be caused by the presence of competing substrates, such as toluene, xylenes and ethyl benzene, as well as inadequate geochemical conditions and lack of proper electron acceptors (nitrate, sulfate, iron, etc.). Therefore, because of the lack of information to correlate site-specific controlling factors to biodegradation, the limited number of field data, and the field and laboratory evidence that benzene tends to be recalcitrant to anaerobic

biodegradation, biodegradation of benzene was not considered directly in the 1995 analysis or in the April 8, 1997 NODA analysis[51].

Comment 2: EPACMTP-simulated groundwater exposure concentrations for the onsite landfill hydrorefining and hydrotreating catalyst scenarios are too high because biodegradation of benzene was ignored. An EPACMTP simulation conducted by API using a worst case decay rate resulted in groundwater concentrations approximately equal to the MCL for benzene. (API, 00046)

Response: See response to Comment 1.

Comment 3: Although EPA recognizes that biodegradation may be a significant removal process, they discounted the process in the groundwater pathway analysis by citing that the literature data are not consistent with EPA's protocol. This decision seems to be <u>very arbitrary and inconsistent with the selection of other parameters</u>. Simulations were performed using the EPACMTP model and peak receptor well concentrations were nine orders of magnitude below the no biodegradation results when a reasonably conservative decay rate of 0.004/day was employed. (Shell, 00047)

Response: See response to Comment 1.

Comment 4: The groundwater risk analysis is also overly conservative in that it does not adequately account for benzene biodegradation which occurs naturally. (Mobil, 00033)

Response: See response to Comment 1.

Comment 5: Although adequate peer-reviewed investigations show that benzene biodegrades in groundwater, this accepted phenomenon was not considered in this listing proposal. Ideally EPA should quantitatively include a biodegradation factor in its risk calculations for CSO sediment, and spent hydrotreating and hydrorefining catalysts. (Phillips, 00055)

Response: See response to Comment 1.

E.   UNCERTAINTY ANALYSES: The Agency requested comments on how best to factor uncertainty into the Agency's listing determinations, and specifically requested comments on if a risk estimate has a high degree of uncertainty, should the Agency consider listing the waste only if the calculated risk is near the high end of the risk range of 10^{-6} to 10^{-4}? Should the calculated risk estimate be even higher? The Agency also asked whether it is accurate to assume that greater uncertainty generally results in a more conservative risk assessment?

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[51]Supplemental Background Document, Groundwater Pathway Risk Analysis, Petroleum Refining Process Waste Listing Determination. 1997.

Comment 1: The commenter noted that because the uncertainty in indirect exposure assessment can lead to a substantial overestimation of risks, failure to consider uncertainty can result in listing decisions for refining process residuals that do not actually pose significant risks. The commenter supported this assertion with the attachment of Price et al., (Uncertainty and Variation in Indirect Exposure Assessments: Analysis of Exposure to Tetrachlorodibenzo-p-dioxin from a Beef Consumption Pathway, *Risk Analysis*, In press). The commenter suggested that EPA could account for the uncertainty in indirect exposure assessment through a quantitative probabilistic uncertainty analysis. If this is not feasible, EPA should use the approach suggested in this rulemaking (60 FR 57762), which proposes to list wastes associated with substantial uncertainty only if the estimated risks are at the high-end of the risk range. (API, 00046)

Response: The Agency agrees that an uncertainty/variability analysis is desirable. A quantitative uncertainty and variability analysis has been conducted in support of this listing decision. A detailed description of this analysis is presented in the Supplemental Background Document for the Uncertainty Analysis: NonGroundwater Risk Assessment; Petroleum Refining Waste Listing Determination The results of this analysis support the results of the deterministic analysis presented in the Notice of Data Availability (NODA) (62 FR 16747).

Comment 2: EPA states in its Hazardous Waste Listing Policy that it will consider the "certainty in risk assessment methodology" in its listing determinations for waste streams with risks in the range from $1x10^{-4}$ to $1x10^{-6}$. 59 FR 66077. However, the proposed listing decision fails to provide either qualitative or quantitative information on the uncertainties in the risk estimates used to support the proposed listing decisions for CSO sediments, spent hydrotreating catalyst, and spent hydrorefining catalyst, even though the estimated risks for those residuals fell in the specified range. In fact, EPA's omission of an uncertainty analysis is also inconsistent with the Agency's own guidance in the Exposure Assessment Guidelines (57 FR 22888-22938, May 29, 1992) and other Agency guidance documents (EPA, 1989, RAGS; EPA, 1995, EPA Risk Characterization Program, Memorandum from C. Browner and Attachments, March 21)[52].

In this rulemaking EPA has performed an estimate of the magnitude of the interindividual variation in risk estimates by developing scenarios for both typical and high-end exposed individuals. However, these scenarios do not provide adequate insight into the impact of many of the most uncertain exposure parameters - namely, biotransfer factors, food consumption rates, biodegradation, land application rates, and physical transport processes. Thus, EPA should

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[52]Even in the absence of EPA's policy, of course, the Agency must explain the uncertainties associated with predictive methodologies in order to rely on such methodologies. *See, e.g., Eagle-Picher Industries v. EPA*, 759 F.2d 905, 921-22 (D.C. Cir. 1985); *Sierra Club v. Costle*, 567 F.2d 298 (D.C. Cir. 1981). *See also*, Office of Management and Budget, Economic Analysis of Federal Regulations Under Executive Order 12866 (Jan. 1996) ("The treatment of uncertainty in developing risk, benefit, and cost information also must be guided by the principles of *full disclosure* and *transparency*, as with other elements of an EA") (Emphasis in original).

include a quantitative analysis of these important sources of uncertainty in the final estimates of risk for the residuals proposed for listing in this rulemaking. (API, 00046)

Response: A quantitative uncertainty and variability analysis has been conducted in support of this listing decision. This analysis addresses the uncertainty associated with constituent concentration, geographical location, size of unit, waste quantity, distance to receptor, ingestion rates, and exposure duration. A detailed description of this analysis is presented in the Supplemental Background Document for the Uncertainty Analysis: NonGroundwater Risk Assessment; Petroleum Refining Waste Listing Determination. These results support the results of the deterministic analysis presented in the Notice of Data Availability (NODA) (62 FR 16747).

In response to commenter's concerns regarding the degree of uncertainty inherent in the groundwater risk assessment, the Agency has conducted two parameter sensitivity analyses for the critical wastestream scenarios and has implemented a Monte-Carlo approach which incorporates a range of values for parameters which exhibit a high degrees of variability, and therefore, uncertainty. In a Monte-Carlo analysis, parameters with a significant degrees of uncertainty are randomly generated or selected from distribution curves. A large number of simulations are performed with a different set of parameters (*i.e.*, individual realizations) for each simulation which results in a range of risk values or receptor well concentrations. This differs from the determination of risk based on one simulation with one set of parameter values. Details of these updated analyses and results are given in the April 8, 1997 NODA docket[53].

F. SOIL TRANSPORT

Comment 1: The procedures used to compute the exposure from ingestion of soil and above and below ground produce grown in these soils is flawed. The transport of soil from the land treatment area to the receptors is not physically possible as described by EPA, therefore, there is no direct or indirect exposure to these subpopulations from soils. (NPRA, 00015; Valero, 00051)

Response: The procedures used to compute the exposure from ingestion of soil and above and below ground produce grown in these soils has been substantially revised to reflect soil erosion in an integrated setting approach. This method was described in detail in the Supplemental Background Document for the NonGroundwater Risk Assessment which was prepared in support of the NODA (62 FR 16747) published April 8, 1997.

Comment 2: In the soil loss equation, EPA uses a USLE length slope factor of 1.5 which corresponds to a slope between 8-10 percent with a default standard or default value of 9%. It is unreasonable to assume that the slope of a land treatment area would be 9% on a 150 foot long plot, or 11% on a 75 foot long plot, especially with the assumptions EPA made on the USLE erosion control factor. EPA also assumes no erosion control (P=1.0), which is very unlikely if the

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[53]Supplemental Background Document, Groundwater Pathway Risk Analysis, Petroleum Refining Process Waste Listing Determination. 1997.

slopes were as steep as EPA assumes. Even using contour tillage, the P factor drops to 0.6 which would reduce the risk by 40%. As a point of comparison, the slope assumed by EPA for the analysis is greater than the 6% grade allowed on an Interstate Highway and the 1% grade allowed on an urban Interstate Highway (Design Standards Interstate Highway System, ASHTO, 7/91, p. 4). (NPRA, 00015; Total, 00039; Valero, 00051)

Response: In the USLE, the length-slope factor is "the expected ratio of soil loss per unit area from a field slope to that from a 72.6 ft length of uniform 9 percent slope" all other conditions being equal (U.S. Department of Agriculture, 1978. Predicting Rainfall Erosion Losses). This is a very site specific term. The variability in the soil erosion model is addressed in the uncertainty and variability analysis conducted in support of this rule.[54] For this analysis, each onsite and offsite facility is modeled individually and site specific estimates of USLE values are used in estimating the soil erosion in the analysis. These results support the findings presented in the NODA. Detailed description of the analysis and findings are provided in the Supplemental Background Document for Uncertainty Analysis: NonGroundwater Risk Assessment: Petroleum Refining Waste Listing Determination.

Comment 3: EPA uses an equation in Table E-18 Appendix E Indirect Exposure Model to calculate the rate that the contaminants originating from the source and computed by the soil loss equation are delivered to the site location. There is no documentation/citation for this equation. The equation used by EPA simply multiplies the rate of erosion from the soil loss equation times the area of the site and adjusts the result by a "soil delivery factor". The soil delivery factor is 10% for the central tendency receptor and 50% for the high end receptor. The only way that the delivery factor could be as high as 10% or 50% would be for the garden to be specifically located in a defined drainage area downstream from the land treatment area. But even if this were the case, this garden would only be one garden and not be representative of all garden areas surrounding the land treatment area.

Further, according to the *Applied Handbook of Hydrology, Chapter 17 (pp. 17-12)*, the soil delivery factor is a function of a number of physical characteristics of the watershed such as size of drainage area, topography, channel density, and relief. None of these factors are included in the analysis. (NPRA, 00015; Valero, 00051)

Response: The method for estimating soil erosion from land treatment units has been revised to reflect the integrated approach to soil erosion. This method was described in detail in the Supplemental Background Document for the NonGroundwater Risk Assessment; Petroleum Waste Listing; Interim Notice of Data Availability which was prepared in support of the NODA (62 FR 16747) published April 8, 1997. The "soil delivery factor" does not appear in the revised methodology. The revised method estimates the sediment delivery ratio for the nearest water body and assumes that the soil eroded from the source that does not reach the stream is deposited

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[54] U.S. EPA. Uncertainty Analysis for NonGroundwater Pathway Risk Assessment; Petroleum Refining Waste Listing Determination; USEPA, 1998.

evenly over the subbasin. The basic assumptions in this analysis for the sediment delivery ratio are:

- The sediment delivery ratio (SD_{SB}) and the soil loss rate per unit area (X_e sub-basin) are assumed to be constant for all areas within the sub-basin, but may be different for the watershed outside of the sub-basin.

- The amount of the soil deposited onto the field is estimated by assuming that the fraction of soil that does not reach the water body ($1-SD_{SB}$) remains in the sub-basin.

It is assumed in the integrated setting that all receptor sites are downgradient from the source and within the same defined subbasin as the LTU. The home gardener or subsistence farmer scenario represents only a single individual at a site. Population risk is discussed in Section IV.B of the NODA response to comments document.

Comment 4: EPA uses an equation in Table E-17 Appendix E Indirect Exposure Model to calculate the rate the contaminants are deposited at the receptor site. Again, there is no citation for this equation. A similar equation is defined in the *Applied Handbook of Hydrology, Chapter 17 (pp. 17-27)* to determine the rate of sedimentation. However, in comparing the two equations, two parameters have been omitted from EPA's equation E-17. The trap efficiency of the receptor, i.e., the ability of the receptor location to trap the sediment from flowing beyond the receptor site, and the specific weight of the sediment are not included in EPA's calculation. The weight of the sediment is probably such that it would fall out in a short distance in the channel carrying the runoff away, or in any wide spots in the channel. Thus, again it is unlikely that any receptor would receive any soil. (NPRA, 00015; Total, 00039; Valero, 00051)

Response: The equations used to estimate soil erosion have been revised to reflect the integrated settings approach. This method was described in detail in the Supplemental Background Document for the NonGroundwater Risk Assessment; Petroleum Waste Listing; Interim Notice of Data Availability which was prepared in support of the NODA (62 FR 16747) published April 8, 1997. This approach does not include channeling because insufficient site specific information is available on all sites to use this approach for a regulatory decision applicable to all current and future facilities.

Comment 5: The Soil Delivery Fraction used by EPA should be zero. The approach used by EPA is not physically possible and is contrary to the principles of surface water hydrology. Surface runoff will flow over the ground and through channels to the lowest point on the land treatment area unless directed or managed by ditches or other types of "channels". Once it leaves the land treatment area, the surface runoff will flow as a "stream" either in a creek, or ditch which is either natural or man-made, to the nearest watercourse. The runoff after leaving the land treatment area does not flow uniformly across the landscape. It will always flow in a "channel" moving downstream toward the outlet of the basin or watershed. Unless all receptors are located

within the stream bed downstream from the land treatment unit, the runoff cannot reach the gardens, farms, and adult residents, and therefore cannot deposit soil from the land treatment area. EPA also assumes uniform population distribution around the land treatment unit and does not assume all the houses, gardens, and farms are located within the banks of rivers and streams.

Under extreme flow conditions, such as a flood, runoff could move outside the stream or river banks and onto adjacent property. However, under these worst case conditions, the runoff and sediment from the land treatment area would only be a small portion of the total flow, and there is no way to predict if any soil particles from the land treatment area would actually reach and be deposited at the receptors (home gardens, farms, adult residents). (NPRA, 00015; Total, 00039; Valero, 00051)

Response: The equations used to estimate soil erosion have been revised to reflect the integrated settings approach. This method was described in detail in the Supplemental Background Document for the NonGroundwater Risk Assessment; Petroleum Waste Listing; Interim Notice of Data Availability which was prepared in support of the NODA (62 FR 16747) published April 8, 1997. This approach does not include channeling because insufficient site specific information is available on all sites to use this approach for a regulatory decision applicable to all current and future facilities.

Comment 6: The assumption that 100% of deposited constituents are bioavailable is overly conservative. This assumption is overly conservative because many constituents, particularly PAHS, bond tightly to soils and are unlikely to be available to an organism even if the soil is ingested. (EEI, 00026)

Response: The process by which ingested soil bound PAHs become more or less bioavailable in the digestive tract is not well understood. Study results are conflicting.

The oral bioavailability of PAHs in rats, hamsters, or humans from diet or oil is approximately 92 percent[55]. A recent abstract report presented the bioavailability of PAH from soil in terms of Relative Absorption Fraction (RAF). RAF represents the fraction of the BaP in soil that is absorbed relative to the BaP in the diet.

$$RAF = \frac{fraction\ of\ BaP\ absorbed\ soil}{fraction\ of\ BaP\ absorbed\ diet}$$

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[55]Ruby, M.V. 1997. Determining the oral bioavailability of PAHs from soil. Preprints of Papers Presented at the 214th ACS National Meeting, Las Vegas NV. September 7-11, 1997. American Chemical Society. 37(2):237-238.

RAFs reported in this abstract varied from 0.07 to 0.75 with an average of 0.29 based on 3 animal studies[56]. This variability in the bioavailability soil-bound PAHs may be expected based upon soil type because PAH sorption to soil increases with increasing soil organic carbon content and particle surface area (Southworth,1979; Sullivan and Mix, 1985; Karickhoff et al., 1979; Gardner et al., 1979). The gastric absorption of PAH may be inhibited by sorption to soil particles with high organic content or may be enhanced by the presence of oils and fat in the gastrointestinal tract. In fact, the sorption of PAHs to organic soil may be minimized (practically neutralized) by the emulsifying action of bile (lipolysis) in gastrointestinal absorptions. However, sorption of PAHs to organic soil has been demonstrated to be minimized and bioavailability increased by the emulsifying action of bile (lipolysis) in the gastrointestinal tract (Rahman et al. 1986). In addition, when mixtures of PAHs (pyrene, benz[a]anthracene, chrysene, benzo[b]fluorene, benzo[k]fluorene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, dibenz[a,h]anthracene, benzo[g,h,i]perylene) were fed to mice in different diet matrices results indicated that the matrix had little effect on the bioavailability of the PAHs (Wu et al. 1994).[57] Due to uncertainty regarding the bioavailability of PAHs the Agency believes it is appropriate to assume PAHs to be 100 percent bioavailable in order to be protective of human health regardless of soil characteristics. However, in the case of the risk assessment conducted in support of the petroleum refining waste listing decision, direct ingestion of soil is not a driving pathway and even if the risk from soil ingestion were reduced by an order of magnitude or more it would not affect the total indirect risk to individuals raising home produced fruits and vegetables near petroleum refineries managing CSO sediment in onsite LTUs.

Comment 7: EPA used an adaptation of the USLE to calculate the concentration of constituents at an offsite receptor location from run-off from a land treatment unit. As part of the calculations, EPA calculated a loss constant due to leaching using evapotranspiration rates of 53 and 38.1 cm/yr for Houston and Los Angeles, respectively. However, EPA identifies different evapotranspiration rates for use in calculating the average annual recharge (Equation E-1.12 in Appendix E of RTI, 1995). The source-specific evapotranspiration rates referenced in that equation and listed in Volume I of the Risk Assessment Background Document (RTI, 1995) are 83.4 cm/yr and 20.1 cm/yr for the 50th and 90th percentiles at the offsite land treatment unit and 22.7 and 7.31 cm/yr at the onsite land treatment unit. EPA does not provide an explanation for this inconsistency. In fact, EPA explicitly states that meteorological parameters were "identified for the central tendency and high-end meteorologic locations of refineries - Houston, TX and Los Angeles, CA, respectively" (RTI, 1995, Appendix E, p. E-10). (API, 00046)

Response: As part of the uncertainty and variability analysis all meteorologic sites with onsite or offsite land treatment units have been evaluated individually. The data used in this analysis are

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[56]Magee, B., P. Anderson, and D. Burmaster, 1996. Absorption adjustment factor (AAF) distributions for polycyclic aromatic hydrocarbons (PAHs) Human and Ecological Risk Assess. 2(4):841-873.

[57]

presented in the following table. The values used for these parameters for Houston and Los Angeles which were used in the risk analysis performed in support of the proposed rule are also presented below. The correct values for these parameters were used in the spreadsheet calculations, however, several typographical errors appeared in the background documents for the proposed rule ("Assessment of Risks from the Management of Petroleum Refining Waste") and NODA ("Supplemental Background Document; NonGroundwater Pathway Risk Assessment"). The following table (Table III.F-1) presents the values used in the risk analysis performed for the risk assessment for the NODA and for the proposed rule.

Table III.F-1. Parameter Values Used in NonGroundwater Risk Assessment

Factor	Houston	Los Angeles
Rainfall	119.1 cm	28.7 cm
Evapotranspiration	83.4 cm	20.1 cm
Infiltration	22.7 cm	7.3 cm
Runoff	13 cm	1.3 cm

G.   RUNON/RUNOFF CONTROLS

EPA received numerous comments regarding the use of runon/runoff controls for land treatment units, which taken as a whole indicated that there was generally confusion on EPA's assumptions regarding these controls in its risk assessment. The proposed listing determinations (as well as today's final decisions) assumed NO controls for the high end analysis, and 50 percent effective controls for the central tendency analyses.

Comment 1: There is no legal or factual foundation for the Agency's assumption that any plausible mismanagement involving land treatment now or in the future will occur at a facility with run-off controls, much less with controls achieving 50% efficiently. The commenter referenced a 1995 EPA report on state requirements for industrial non-hazardous waste management facilities from which they conclude that 61 refineries are in states that do not required run-off controls on any land treatment units. (EDF, 00036)

Response: EPA conservatively assumed that no runoff controls were present in its high-end analysis of risk to individuals residing near land treatment facilities managing petroleum waste streams because the presence and effectiveness of such controls could not be verified. EPA believed this is appropriate for the high end scenario. The central tendency scenario, however, assumed that controls were in place that were 50 percent effective. The basis for this assumption is two-fold. First, the Agency's 1992 survey asked that refineries characterize whether run-on or

run-off controls were in place at land treatment units used in 1992.[58] Based on the information currently available to the Agency, of the 18 facilities with land treatment units, all reported controls. While it was not possible to quantify the effectiveness of these controls due to the very general nature of the questions and responses, it was obvious that the majority of the facilities provided some level of control. Secondly, EPA conducted site visits at 7 refineries that operated land treatment units as part of its field study. At the four facilities where EPA toured the land treatment units, EPA observed controls designed to divert run-on and collect runoff.

EPA recognizes that the effectiveness of control is dependant on any factors (level of engineering design, operation and maintenance practices, regulatory oversight and minimum standards, weather conditions, etc.), and that the actual effectiveness of the runon/runoff controls at these sites varies, in part because of the lack of Federal land treatment unit standards. As a result, EPA assumed only partial effectiveness, 50 percent controls, for the central tendency analysis, and no controls for the high end analysis. EPA agrees that there is no specific basis for using "50 percent" effectiveness; EPA does not have available to it data that would allow for quantification of effectiveness. This value, however, was selected in order to characterize releases from LTUs where controls known to be widely used have some effect in mitigating releases.

EPA has recognized that no controls are mandated (although the survey indicated that some level of controls are common) and assumed zero controls in the high end analysis and only partial control in the central tendency analysis.

Comment 2: There is ample evidence in the RCRA §3007 Petroleum Refinery database that land treatment units do have erosion controls. Moreover, even where there are no Subtitle C or mandatory state Subtitle D regulatory requirements for these controls, numerous other factors are motivating their use, as evidenced by the fact that most facilities currently use them. LTUs require control of soil moisture to provide optimum waste treatment. Fields that are routinely saturated by runon will not operate efficiently. Other factors that may require controls include erosion control and nuisance prevention. EPA's assumption that run-on/run-off controls are not used at land treatment units does not reflect current or expected future practices. (ARCO, 00023; API, 00046; Exxon, 00035; NPRA, 00015; Phillips, 00055; Sun, 00034; Valero, 00051)

Response: EPA agrees that it is not uncommon for controls to be used, and therefore assumed partial control of 50 percent effectiveness in the central tendency analysis. The high end analysis assumed no controls for the risk assessment for the proposed rule. See previous response for details on runoff control.

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[58] 1995 Listing Background Document for the 1992-1996 Petroleum Refining Listing Determination, Appendix C. In response to comments, EPA examined these units further, including the evaluation of data submitted by industry, telephone contact with the facilities, and consideration of permit status data reported in the survey.

Comment 3: EPA has assumed that the residential property and gardens are adjacent to and downhill from the land treatment units. EPA has not provided any evidence to support this assumption. A much more reasonable assumption is that units with a "near-by, downhill" residence will use run-on/run-off controls.

However, the most appropriate approach to deal with this issue is for the Agency to use an analysis similar to that used in the TCLP regulation where EPA used a distribution of distances to the nearest wells. This distribution included instances where the nearest well was sufficiently far away to result in exposures approaching zero. A similar approach could be used to estimate distances between land treatment units and potentially impacted residential plots. Such an approach would also allow consideration of the fraction of units that limit overland flow or which have no impacted residential properties. (API, 00046)

Response: The placement of potential receptors was considered in the uncertainty and variability analysis conducted in support of the risk assessment for this rule. A distribution of hypothetical receptors was developed for each onsite and offsite LTU that reported managing CSO sediment , crude oil tank sediment, or off-specification products and fines and site specific risk distributions were developed. The description of the distribution of hypothetical receptors and the results of this analysis are presented in the Supplemental Background Document for the Uncertainty Analysis: NonGroundwater Risk Assessment: Petroleum Refining Waste Listing Determination.

H.   USE OF THE TCLP

Comment 1: One commenter argued that because the TCLP provides an overly conservative estimate of contaminant leaching in the subsurface, EPA's use of the TCLP in its generic assessment of the potential risks posed by refinery residuals results in a high degree of confidence that the actual risks are lower than EPA's estimates. The TCLP also uses a well-defined mismanagement scenario and is intended for use with the current RCRA hazardous waste toxicity characteristic.

The TCLP is very conservative. The underlying model assumes that the waste is disposed of in a municipal solid waste landfill, where it is leached by acidic landfill liquids, emerges from the landfill bottom into underlying groundwater, and migrates to a hydraulically down-gradient drinking water well. While this may have constituted a plausible worst-case disposal practice in the past, co-disposal of potentially hazardous industrial wastes in a municipal landfill is not a likely mismanagement scenario today.

The TC method for determining risks couples the TCLP, the EPACMTP and a toxicological model. The TCLP was designed to be a water phase model, not a multi-phase model. To apply the TCLP as a realistic multi-phase model of contaminant leaching requires acceptance of the following conservative assumptions:

- • The bottom of the landfill is in direct contact with groundwater;
- • Disposed nonaqueous liquids (i.e., oily liquids) and groundwater are equally mobile in the subsurface;
- • The nonaqueous liquids (i.e., oily liquids) are not leached. They elute directly from the landfill into the groundwater;
- • The continuous release of these liquids proceeds forever (i.e., the source is not finite);
- • The solids in the residual are leached with a 20:1 volume of acidic landfill leachate;
- • The constituent concentrations in the leachate do not decrease over time (i.e., infinite source);
- • The nonaqueous liquids and the leachate travel <u>together</u> at the same rate through the subsurface. Attenuation and dilution reduce concentrations by a factor of 0.01;
- • Constituent concentration reach steady state in the drinking water well and never decrease over time; and
- • The well owner drinks 2 liters/day for 70 years - nonaqueous liquids and all.

The above assumptions ensure that the TCLP will provide extremely conservative estimates of leachate concentrations, contaminant mobility, and contaminant risks. Thus the commenter believes that EPA should be confident that any risks estimated by use of this procedure are likely to be substantially overstated.

Moreover, use of the TCLP in this case to estimate risks from <u>oil-bearing</u> residuals (e.g., CSO and crude oil storage tank sediment) would produce even greater overestimates of potential risks. (API, 00046)

Response: EPA does not agree that the TCLP overestimates leaching levels for these wastes. The commenter's concern that the TCLP was used to model "multi phase" leaching (i.e., leaching of organic and aqueous phases together from wastes) are unfounded. EPA did not, as asserted by the commenter, assume oily liquids elute directly from the landfill to groundwater, because EPA's initial and subsequent[59] analyses showed that oil in the wastes in question was unlikely to migrate from a landfill containing these wastes. Thus EPA did not make any assumptions regarding oily liquid movement in groundwater[60].

While the commenter is correct in stating that the TCLP procedure was designed, in part, to represent leaching from a municipal landfill, the commenter did not provide any information that would support the contention that the TCLP is not appropriate for the landfill scenario modeled by EPA.

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[59]See NODA analyses and response to comments (Section I.C.1) regarding oily wastes.

[60]Petroleum Refining Listing Determination Background Document for Ground Water Pathway Analysis. 1995. Document S0007. Page 6.

The commenter also did not provide any data showing that disposal of petroleum wastes in municipal landfills does not occur, or that such disposal is unlikely or restricted. EPA examined the data collected from EPA's RCRA §3007 Survey and found that, in fact, petroleum refineries reported numerous wastes were sent to municipal landfills. EPA found 146 petroleum wastes that facilities reported were sent offsite to municipal Subtitle D landfills in 1992 (see report entitled "Additional Listing Support Analysis," 1998 in the docket of this rule).

In conclusion, EPA continues to believe that the TCLP was an appropriate model for application to the refinery residuals. The residuals did not exhibit multi-phase behavior in the laboratory and are not expected to result in free oil or NAPL flow in the subsurface environment. In addition, the industry reported significant volumes of residuals being disposed of in precisely the type of landfill modeled by the TCLP.

Comment 2: The TCLP substantially understates the leachability of oily wastes by failing to capture much of the waste leaching potential and presuming the hazardous constituents are migrating in a dissolved rather than free phase flow. The commenters' arguments contained the following elements: (EDF, 00036; ETC, 00038)

1.   The oily composition of many of the wastes of concern is well documented in the record.

2.   The problems with the TCLP (Method 1311) on oily wastes are well documented.

   a.   The HWIR proposal stated "Method 1311 underestimates the mobility of constituents from many oily wastes due to filter clogging problems, can be imprecise for oily wastes, and has several operational problems (60 FR 66390, 12/21/95).

   b.   In the 1990 listing determination for petroleum refinery wastewater treatment sludges, EPA expressly rejected relying upon the TCLP as the appropriate measure of potential oily waste leachability, because the "...newly developed TCLP tends to underestimate the leachability of hazardous constituents from oily wastes."[61]

   c.   In the 1992 listing determination for coke byproduct wastes, the Agency again rejected TCLP results as the basis for measuring waste leachability. The Agency cited the filtration and other technical difficulties associated with use of the procedure on oily or tarry wastes, and thus "...maintain[ed] its belief that the TCLP results may underestimate the concentrations of constituents in leachates...."[62]

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   [61]5 FR 46376 (November 2, 1990).

   [62]57 FR 37294 (August 18, 1992). See also 57 FR 37296 ("The Agency does not believe that the TCLP can be used to determine the leachability of wastes such as K148 that are difficult

d.   The 1990 refinery waste listing determination references an EPA contractor report prepared for the Agency on oily and other wastes that are difficult to filter.[63] The report describes several aspects of the TCLP which result in significant underestimates of leachability using the procedure.

          i.   Wastes can clog the filter before all waste liquids have passed.

          ii.   Errors in the TCLP can cause inaccurate liquid/solid leaching ratios resulting from percent solids determinations that are too high.

e.   The Agency requires a different procedure than Method 1311 in the delisting context to measure metals leachability in wastes containing greater than 1% oil and grease, thereby acknowledging the deficiencies of the TCLP for metals in oily wastes as well.[64]

3.   EPA's proposal never addressed the efficacy of the TCLP or attempted to justify reliance on the procedure.

4.   The TCLP is inappropriate because it fails to consider cosolvency effects.

a.   In the previous petroleum refinery listing determination, the Agency expressly acknowledged the cosolvency effects associated with the solvents and oils present in petroleum refinery land disposal facilities. (54 FR 46369)

b.   No evidence is presented in the instant rulemaking even suggesting that the solvents and oils of concern to the Agency in 1990 are no longer present in the same refining sector land disposal units.

c.   EPA did perform an analysis regarding the potential for free-phase flow from a landfill, but that analysis did not consider potential cosolvent effects associated with the disposal of other or multiple oily wastes and solvents in the landfill. Moreover, the analysis was flawed even for the individual waste stream assessed.

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to filter.").

[63]Evaluation and Modification of Method 1311 for Determining the Release Potential of Difficult-to-Filter Wastes, Prepared by RTI and Dr. Peirce of Duke University, April 1990 (hereafter "EPA TCLP Report"). By letter dated March 1, 1996, EPA submitted a copy of this report for inclusion in the instant rulemaking record.

[64]Petition to Delist Hazardous Wastes: A Guidance Manual (Second Edition), prepared for EPA by SAIC, March 1993, p. 6-11.

5.   EPA inappropriately suggested high oil and grease COST residuals (80 percent) will be adequately captured by the TCLP.

6.   If EPA had not relied on the TCLP, at least 6 wastes would have been listed.

Response: EPA responds to each element of this comment below.

1.   The oily composition of many of the wastes of concern is well documented in the record

EPA believes that the commenter is arguing that the oily nature of the residuals calls for an entirely different assessment due to the potential for free phase flow of the oil fraction of the residuals. EPA contends that the residuals of concern are not oily in the manner anticipated by the commenter. For example, these materials differ dramatically from used oil which is essentially all oil. Crude oil tank sediment, the "oiliest" of all the residuals of concern, was never observed by the Agency during sampling and analysis to exhibit an oily phase.   In the Supplemental Background Document to the NODA, Table 1 summarizes the Agency's field and laboratory observations of the listing residual samples. These materials were generally solid at room temperature, with a tarry or granular consistency. None were observed to exhibit immiscible phases (e.g., separate oil and water soluble phases). The samples were homogenous in nature, often quite solid, and did not generate filtrate during the filtration step of the TCLP. The characteristics of these samples did not lead the Agency to expect free phase oil flow.

As a second means of assessing the potential for free or mobile oil content in the residuals of concern, EPA evaluated the reported oil and grease content of landfilled and land treated wastes, based on data reported in Section VII of the questionnaire submitted by the industry:[65]

> In assessing any waste that was disposed in an *onsite* nonhazardous landfill in 1992, the highest reported oil and grease concentration was 10 percent, with the median value less than 1 percent.[66]

> For residuals disposed in *offsite* non-hazardous waste landfills in 1992, 8 individual wastes were reported to have oil and grease levels over 10 percent, but the median level was approximately 1 percent (oil and grease data were reported for only 120 out of the 621 residuals disposed in offsite nonhazardous waste landfills).

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[65] Supplemental Background Document for Listing Support Analyses, 1997, Appendix A.

[66]EPA notes that it has such data for only one-third of the residuals disposed in this manner; oil and grease data for the other two-thirds of the residuals were not reported. The limitations of these data are discussed further in response to the public comments on the NODA in Section I.C.1.

- EPA conducted further verification of the 8 wastes disposed in offsite landfills with reported oil and grease levels above 10 percent. The two highest levels, for a crude oil tank sludge (80%) and a residual oil tank sludge (99%) appear to represent oil levels prior to deoiling (i.e., the residuals underwent an onsite removal step prior to being landfilled, and the oil content of the landfilled material was not provided). The remaining 6 wastes had oil & grease levels ranging from 12 to 30 percent. Only one of these wastes was one of the 14 residuals considered for listing under this rulemaking (CSO sediment with 20 percent total oil & grease); the other 5 were residuals identified for study under the EDF consent decree. Two of these study residuals, both with 20 percent oil and grease levels, were accompanied by lab results. One sample was described as having no free liquids as determined by the paint filter test[67], and another was described as having 93 percent solids and 7 percent liquids (which indicates that most of the oil is bound to the solid matrix).

- Removing the 2 highest data points (80 and 99 percent) from the data set (because they do not reflect oil levels in wastes actually landfilled) reduced the average oil and grease level in these wastes with the highest oil and grease content to 19 percent. The median oil and grease content of all wastes landfilled remained approximately one percent.

These findings (i.e., median oil and grease levels at or below 1 percent) support EPA's conclusion that wastes with high oil, high mobility fractions are not land disposed.

After conducting these assessments, the Agency continues to assert that its original assessment of the potential for free phase flow was adequate and that these wastes in general should not contain sufficient free oil to result in non-aqueous phase liquid (NAPL) generation.

2.   The problems with the TCLP (Method 1311) on oily wastes are well documented.

As described further below, EPA has carefully assessed the appropriateness of its methodologies, both analytical and risk assessment, for wastes with measurable oil content. This assessment has been ongoing throughout the petroleum refining industry study, as well as in response to the commenter's concern.

When initially developing the Quality Assurance Project Plan (QAPjP) for this project (available in the docket for the proposed rule) in 1993, EPA made provision for a familiarization sampling and analysis effort to ensure that the targeted constituents of concern could be adequately and reliably quantified. As noted by the commenter, higher oil content matrices and complicated organic matrices can pose serious difficulties to analytical characterization. In particular, the high level of

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[67]EPA. "Test Methods for Evaluating Solid Wastes, Physical and Chemical Methods.: Third Edition, Update 3. SW-846, 9096A. 1997.

organics associated with these types of materials typically caused significant interference problems with analyses of organic constituents. The familiarization effort was designed to assess these potential problems for the petroleum refining industry study.

During the familiarization study, EPA selected six residuals[68] which were expected to pose the most serious analytical challenges and represented the range of matrices expected to be encountered.[69] Three contract laboratories conducted analyses of these residuals, with the goal of identifying and solving analytical problems associated with the expected complex nature of these diverse matrices. The laboratories did not find any serious problems with these matrices and were generally able to achieve the target quantitation limits[70].

The record sampling and analysis program proceeded smoothly with minimal problems associated with the conduct of the prescribed methodologies. The contract laboratory was generally able to achieve the targeted quantitation limits and QA/QC limits were generally met. Overall, the quality and reliability of the Agency's data were excellent. These findings were confirmed by the comparison of split samples collected and independently analyzed by API.[71]

The reliability of the waste characterization extended to the TCLP results. Each of the samples collected by the Agency was subjected to both total and TCLP constituent analyses (except those residuals which were liquid by nature such as spent caustic and did not require aqueous extraction). In no cases did the laboratory report any difficulties in the conduct of the TCLP. EPA reviewed the analytical data reports and laboratory logs for 38 samples of the 8 residuals expected to be the most oily. No filtration difficulties were reported. In the Supplemental Background Document to the NODA, Table 1 summarizes these findings. The commenter's concerns regarding problems previously reported with the filtration step of the TCLP were not observed in the familiarization or record sampling and analysis program. Table 1 also demonstrates that none of the samples subjected to the TCLP were reported to exhibit heterogeneous layers or emulsions. The commenter's concern regarding the potential for two-

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[68]Quality Assurance Project Plan for Familiarization Sampling Under the 1992-1996 Petroleum Refining Listing Determination and Industry Study. October 21, 1992.

[69]The targeted residuals of concern were crude oil tank sediment, catalyst from hydrotreating, sulfur complex sludge, spent caustic, acid soluble oil and sulfuric acid alkylation catalyst.

[70]Target quantitation limits are established as detection limit goals for the laboratory. For example, EPA established TQLs for benzene of 10 ug/L in aqueous matrices. When analyzing these matrices, the laboratories attempted to quantify benzene at levels at least this low.

[71]See Appendix B to the 1995 Listing Background Document, "*Comparison of EPA and API Laboratory Results as Part of the 1992-1996 Petroleum Refinery Listing Study*", July, 1996, in the docket to today's rule.

phase flow and the formation of NAPLs was not substantiated by the Agency's observation and laboratory analyses of over 100 samples of the residuals of concern.

> *a.   The HWIR proposal*

The HWIR proposal has broad applicability and is designed to provide regulatory relief to any hazardous waste that meets its generic criteria. To address concerns that the program might be overly broad, EPA raised a number of issues in the HWIR proposal that were associated with specific types of wastes where the generic exemption criteria might not address waste-specific characteristics. One of these issues was the effectiveness of the TCLP in predicting leaching from the general category of oily wastes, based in part on the operational problems documented in the RTI report (discussed further below). In conducting the petroleum refining field investigation supporting this rulemaking, EPA kept these considerations in mind throughout the sampling and analysis program. As documented elsewhere in this response, the specific concerns raised in the HWIR rule associated with the broad class of oily wastes were not found to be warranted with the specific subset of oily wastes investigated in this rulemaking.

> *b.   The 1990 listing determination for petroleum refinery wastewater treatment sludges*

The commenter referenced a discussion in the 1990 listing determination where EPA was responding to comments from industry that the TCLP results for the primary sludges did not support EPA's claim that F037/F038 should be listed as hazardous. EPA's response was that it was inappropriate to rely entirely on the characteristics as the basis for listing determinations because ... "[t]he Agency has always maintained that wastes that do not exhibit any of the promulgated characteristics may still be hazardous for other reasons (e.g., mismanagement scenarios unaccounted for in the TC)." EPA goes on to discuss the findings of the RTI report, which characterized several oily wastes. While the findings of the RTI report may have some applicability for the 1990 sludge listing, as discussed below in part d. of this response, the specific concerns raised by the 1990 listing associated with the wastewater treatment sludges were not found to be warranted with the specific subset of oily wastes investigated in this rulemaking.

> *c.   The 1992 listing determination for coke byproduct wastes*

The commenter referred to a section of the coke by-products preamble where the Agency discussed its reasons for not using the TCLP to characterize leaching from the coke by-products residuals. For these wastes, EPA's laboratory analysis confirmed that the TCLP was not working well:

> "As stated in July's proposed rule, the tarry samples analyzed in support of today's rulemaking were found to pose problems with sample homogenization, filtration, and dispersion of solids in the leaching medium due to the varying amounts of tar in the wastes. Due to these analytical problems, the Agency maintains its belief that the TCLP

results may underestimate the concentrations of constituents in leachates generated from the proposed wastes and should not be used as a basis for listing these wastes." 57 FR 37294.

As discussed elsewhere in this response, EPA did not encounter these types of problems during the analysis of the petroleum refining residuals of concern or any other analytical issues that would indicate that the TCLP was not performing as designed.

d. *The RTI report*

The commenter referred EPA to the RTI report titled "Evaluation and Modification of Method 1311 for Determining the Release Potential of Difficult-to-Filter Wastes" dated April 1990 that studied the effectiveness of the TCLP (Method 1311) with oily wastes and an alternative filtration procedure designed to simulate the movement of oily wastes into soils beneath landfills. The study evaluated four oily wastes, two of which were obtained from operating petroleum refineries: slop oil emulsion, and API separator sludge. These petroleum wastes were described as multiphasic and extremely heterogeneous and difficult-to-filter (see p. 7 of RTI's report). This contrasts to the petroleum listing residuals that were identified as all single phased without free liquid and considered to be homogeneous wastes. For this reason the RTI report is not considered directly applicable to the petroleum listing residuals.

i. *Wastes can clog the filter before all waste liquids have passed.*

The RTI report suggests that the current TCLP Method 1311 underestimates the release potential of toxic constituents when difficult-to-filter wastes are characterized according to the existing filtration procedure. The report indicates that the glass fiber filter media recommended in Method 1311 easily clogs using oily matrices thereby inhibiting the determination of analytes in the filtrate or primary leachate. RTI evaluated several potential changes to the TCLP in an attempt to address this problem. The leachate results along with the percent solids retained using a modified filter apparatus were compared to those from soil column experiments and the current Method 1311 procedure. There were no statistical differences in API separator sludge percent solids retained and leachate results using the modified and current Method 1311. However, less solids were retained and additional analytes were detected in the slop oil emulsion using a modified procedure. The RTI report concluded that the current Method 1311 was adequate for filterable wastes, but not as accurate as modified filtration procedures for the difficult-to-filter wastes (see p. 79 of the RTI report).

ii. *Errors in the TCLP can cause inaccurate liquid/solid leaching ratios resulting from percent solids determinations that are too high.*

The RTI report noted that certain difficult-to-filter wastes may cause TCLP Method 1311 filter clogging and thereby overestimate the waste percent solids used to calculate the liquid leaching volume. The report concluded that the resulting excess leaching fluid may dilute the final leachate

concentrations if the solubility equilibrium is not achieved during the 18-hour leaching period. The Agency agrees that multiphasic and difficult-to-filter wastes that fail to produce a filtrate upon filtration could potentially result in excess leachate volume since these wastes are considered to be 100 percent solids for leaching purposes.

After carefully examining the data developed by RTI, EPA concludes that, except for perhaps API separator sludge, three of the wastes evaluated by RTI are dramatically different from the listing residuals of concern in this rulemaking. The slop oil emulsion and used motor oil samples had 40-100 percent oil content (see p. 41 of RTI's report). All four of the wastes were called "multiphasic" in the report (see p. 7 of RTI's report), indicating the apparent presence of free oil. All exhibited filter clogging and underestimation of liquid fraction. The conclusions that can be drawn from RTI's data for API separator sludge support EPA's use of the TCLP to characterize the petroleum residuals of concern. The conclusions drawn from the RTI report regarding the other three wastes are not applicable to the wastes of concern in the current rulemaking.

> ### e. The Delisting method

Method 1330, the Oily Waste Extraction Procedure (OWEP), was developed in an attempt to model the release of metals from an oily waste matrix after the oil degrades, releasing the maximum leachable amount of metals. EPA did not include this method in its analytical protocols for the petroleum refining listing determination because EPA was concerned that it may over estimate the leaching potential of metals from wastes. This method is very aggressive and uses strong organic solvents to leach out organic material, followed by extraction with an acidic aqueous solution. The mobile metal content is then calculated from metals measured in the organic and aqueous extraction. Such a procedure may cause drastic changes in the original waste matrix. However, in response to the commenter's concern, EPA retrieved 27 samples of eight listing residual categories from the laboratory archives and ran the OWEP for 7 metals to assess any differences in metals mobility between the TCLP and the OWEP (percent oil and grease was also measured for these samples).[72] Of the 189 data pairs generated by this analysis, only 14 showed higher leaching rates using the OWEP when compared to the TCLP results and were within 1 order of magnitude of the TCLP results. Based on the results of this analysis, EPA concludes that oil content (as measured by total oil and grease) does not appear to impact the mobility of metals in the wastes relevant to this rulemaking.

> ## 3. EPA's proposal never addresses the efficacy of the TCLP or attempts to justify reliance on the procedure.

As discussed above, EPA has conducted a variety of analyses to establish the adequacy of the TCLP as a tool to predict leachability for this rule. EPA also recognizes that the available methodologies, whether the TCLP or the OWEP may over predict leaching for some samples and

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[72]Supplemental Background Document, Listing Support Analyses; Petroleum Refining Process Waste Listing Determination. S0021. EPA. March, 1997.

wastes, and under predict leaching for others. In the Supplemental Background Document to the NODA, Table 2 compares the measured total and TCLP results with measures of calculated leachability.

EPA examined the existing analytical data for the petroleum wastes to see whether oil content significantly affected the leachability of a key organic constituent (benzene). EPA calculated the percentage of available benzene that the TCLP showed to be mobile, as summarized in the fourth column of Table 2. For the 27 samples for which the percentage of benzene leached could be calculated, the average sample leached 53 percent of the total mass of benzene contained in the residual. This leaching rate was fairly consistent regardless of whether the waste was oily (crude oil tank sediment, CSO sediment, and HF alkylation sludge: average leaching rate, 46 percent) or non-oily (all other listing residuals of concern with oil and grease content less than 1 percent: average leaching rate, 52.9 percent). These results indicate that the TCLP mobility of a typical organic constituent, benzene, is not adversely affected by the oil content in these wastes.

4.   The TCLP is inappropriate because it fails to consider cosolvency effects.

While cosolvency effects may exist, the Agency has never been able to develop an adequate means of assessing any potential increases in toxicant mobility in refinery landfills. However, this is offset by several factors. First, the TCLP does measure mobility due to cosolvency within a given residual, i.e., the TCLP results reflect any "cosolvency" leaching caused by the organic chemicals in the waste samples themselves. Secondly, the listing determination finalized in this rule focused on those residuals originally examined in OSW's 1983 survey of the refining industry and subsequently identified in the EDF consent decree as the petroleum residuals of most concern (e.g., those posing potential leaching or co-solvency risk). These residuals have been thoroughly evaluated over the course of the Agency's industry study and risk assessment. The Agency has no reason to conclude that other residuals, not characterized as one of the 29 consent decree residuals, would exert much risk or potential for increasing co-solvent effects. EPA found that very few of the 29 residuals of concern with significant oil content are sent to landfills; the Agency is not convinced that these limited oily wastes present a significant potential for increasing co-solvent effects. Third, the promulgation of the Toxicity Characteristic is likely to have removed many of the wastes containing highly mobile solvents from Subtitle D landfills, reducing the potential for co-solvent effects. The TC rule regulates many chemicals that were commonly used as solvents (e..g, trichloroethylene, tetrachloroethylene, carbon tetrachloride, methyl ethyl ketone; see 261.24) in addition to benzene, a common constituent in petroleum wastes. Thus, wastes containing appreciable concentrations of these chemicals would thus be regulated as hazardous and can no longer be codisposed with nonhazardous waste. Fourth, the promulgation of 1990 sludge listing also removed significant volumes of multiphasic oily wastes from Subtitle D landfills, further reducing co-solvency risks.

a.   Previous petroleum refinery listing determination

As the commenter noted, in an earlier listing of other petroleum refinery wastes (primary and secondary pile/water/solids separation sludge, F037 and F038 respectively), EPA argued that the toxic constituents in the wastes (PAHs) may be expected to become mobilized by cosolvency effects because they "typically contain high concentrations of oils" (55 FR 46369). However, as noted earlier in this response (as well as in Section I.C.1 of the NODA Response to Comments), the existing information indicates that the wastes under examination in the current rulemaking do *not* typically contain high levels of free oil, and that the wastes sent to landfills typically do not have high oil content. Furthermore, the listing of F037/F038 sludges also relied on damage cases and noted that much of the sludge was generated and stored/disposed of in surface impoundments, resulting in groundwater contamination (55 FR 46370). In the current rulemaking, EPA could not find any convincing damage cases (i.e., environmental risks caused by the residuals under examination), nor were the oily wastes of concern disposed of in surface impoundments.

> b. *No evidence that the solvents and oils of concern are no longer present in the same refining sector land disposal units.*

EPA agrees that it cannot present quantitative evidence that solvent and oil content of land disposed materials has been reduced over the past eight years. However, as discussed above, a number of factors may have resulted in such a reduction. Promulgation of the TC increased the number of solvents that cannot be land disposed, with a specific impact on the petroleum refining industry due to D018 (benzene). Promulgation of the 1990 sludge listings also reduced the volume of oily wastes placed in Subtitle D landfills. While EPA has not quantified the change in volumes of solvents and mobile oily wastes landfilled over the past eight years, clearly the TC and sludge listings have reduced the risks associated with landfilling refinery wastes. Further, the promulgation of today's rule will remove additional high risk wastes from Subtitle D landfills (although EPA's data demonstrate that these wastes are not likely to exhibit free phase flow or NAPL formation).

More importantly, however, the commenter is referring to a discussion in the 1990 preamble in which EPA was building a case for the risk estimation methodology used to support that rule. This methodology was a simplistic calculation of dilution and attenuation factors that was EPA's only means of estimating ground-water risk at that time (55 FR 46369). At the time of the 1990 rulemaking, the TCLP method was a new procedure and EPA did not yet employ such data as input for groundwater modeling. Since 1990, EPA's risk assessment abilities have become significantly more sophisticated, allowing EPA to model indirect, as well as groundwater pathways. The results of the recent risk assessments shows that the primary risk pathways for PAHs, the constituents of concern from a co-solvent perspective, are the indirect pathways due to the bioaccumulation of these compounds in the food chain. These pathways were not evaluated in detail at all in the 1990 analysis. EPA believes that the current risk assessment methodologies have moved well beyond the limitations of the 1990 analysis.

*c.   Free-phase flow analysis did not consider potential cosolvent effects and was
        flawed*

EPA does not believe these wastes pose a risk of accelerated leaching due to co-solvent effects
during co-disposal because (1) all analyses indicated that the TCLP provided an adequate measure
of leaching, (2) the wastes of concern do not exhibit multi-phase flow, and (3) residuals that are
land disposed tend to contain relatively low levels of oil (See Response to Comment 6 in section
III.I of this response to comment document). Therefore, the Agency's free-phase flow analysis
was adequate to assess the risk due to the presence of NAPL in petroleum refining waste.

*5.   EPA inappropriately suggests high oil and grease COST (80 percent) will be adequately
        captured by the TCLP.*

In response to this comment, EPA examined the data point cited by the commenter to determine if
in fact sediments with 80 percent oil and grease were being landfilled. EPA determined that the
high value cited by the commenter of 80 percent oil content was a coding error and is not
associated with material placed in a landfill. One refinery[73] reported generation of crude oil
storage tank (COST) sediment with oil content of 80 percent directly after removal from the tank.
The facility subsequently conducted oil recovery on this residual, but neglected to report the oil
content of the residual after the recovery step. The 80 percent value was inappropriately carried
over to the de-oiled secondary residual, giving the commenter the erroneous impression that
extremely high oil content residuals were being land disposed.[74] The Agency continues to assert
that the oil content of 27 percent assumed by the Agency in its assessment of free phase flow for
the proposal is reasonable, if not high, in terms of actual reported values in the survey and the
Agency's observations during sampling and analysis. See Section III.K, Comment 1 of this
response to comment document for additional discussion.

6.   If EPA had not relied on the TCLP, at least 6 wastes would have been listed.

To summarize the discussion presented above, EPA has closely evaluated the appropriateness of
the TCLP to characterize the mobility of toxicants from the petroleum refining residuals of
concern:

•   These residuals differ from the oily wastes characterized by the commenter because they
        are generally solid, homogenous, and do not contain free oil, as confirmed by field and
        laboratory observation.

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[73]Facility Number 19, ARCO, Los Angeles Refinery, Carson, CA.

[74] Supplemental Background Document for Listing Support Analyses, 1997, Appendix A.

- The high level of oil and grease content referenced by the commenter of 80 percent was incorrectly associated with landfilled residual, reflecting levels prior to de-oiling and subsequent disposal at that facility.

- The contract laboratory did not encounter complications or QA/QC problems during the conduct of the TCLP.

- The results of the NODA OWEP analyses confirm the adequacy of the TCLP, showing no significant increases in leaching due to the use of a much more aggressive leaching media.

- The calculation of percent leachability also confirms that the TCLP results are reasonable and that matrix effects were not evident.

In conclusion, EPA continues to believe that the TCLP results adequately predict leaching from the residuals of concern.

I.   VOLUME INPUTS AND WASTE FRACTIONS

Comment 1: EPA has not recognized the potential increase in the cost to the regeneration business. EPA has not considered the shift in current waste management practices as a result of this proposal and has greatly underestimated the volume of waste requiring treatment prior to disposal. Not all of the current regeneration facilities will be willing to accept a listed hazardous waste for processing due to the implications associated with permitting and residues generated during the regeneration process. (Eurecat, 00021)

Response: EPA recognizes that the waste generators, treaters, recyclers and disposers of the residuals being listed as hazardous through this rulemaking will necessarily undergo changes in operating practices in response to the new listings. EPA has not, however, received any data indicating that treatment capacity will be significantly compromised. See response to comments on the capacity related comments to the Land Disposal Restrictions in Section X.

Comment 2: The modeled volumes and practices merely reflect a snapshot in time, not potential waste management volumes and practices that may occur in the future. (EDF, 00036; ETC, 00038)

Response: The commenter is concerned that waste volumes might increase in the future, and thus the risk associated with these residuals would increase. In general, it is logical that higher production rates can result in higher waste generation rates. However, given the high production levels of 1992 (91.6 percent refinery utilization, as reported in the 1992 Petroleum Supply Annual, Energy Information Administration), the Agency believes that the 1992 survey results provide a good characterization of the industry's waste generation potential. Several other factors offset potential increase in risk associated with further elevations in waste generation rates:

- The groundwater model sensitivity analysis showed that waste volume was frequently one of the two high end parameters. Thus the risk assessment relies heavily on high end, rather than central tendency, volume values.

- The Agency is listing 4 of the 14 residuals targeted for listing determinations. These residuals account for a significant percentage of the targeted wastes that were landfilled and placed in land treatment units. Thus the toxicant loading to these units will be reduced significantly as a result of this rulemaking, regardless of the overall residual generation rate.

- EPA is promulgating important modifications to the definition of solid waste in today's rulemaking. These changes will allow refiners to increase the amount of residuals that are recycled to the refining process, thereby reducing the volume of waste requiring disposal and improving resource recovery.

In addition, EPA reviewed API's "Generation and Management of Residual Materials, 1992-1993" Appendix C, which provides trends of waste generation from 1987-1993. Generally, 1992 was representative when comparing waste generation and management for the API waste categories and the residuals under review. Only hydroprocessing catalysts showed a slight increase in production that year possibly due to the new low-sulfur diesel regulations.

In developing reasonable management scenarios for subsequent risk assessment modeling, EPA considered some potential shifts in management practices. These considerations are discussed in the context of each specific waste (see Section IV of this response to comment document). For the remaining residuals, EPA considered the industry to be stable, and thus assumed that 1992 provided a reasonable picture of the petroleum refining industry's practices. EPA's approach was not "forever fixed," but used 1992 as a reasonable starting place for assessing the industry's waste generation and management practices.

Finally, EPA notes that its survey of refineries was a complete census of the industry, and gathered information from all active petroleum refineries in the United States. It is reasonable for the Agency to conclude that the large amount of information gathered in its 1992 survey of petroleum refineries related to waste generation, management, and disposal practices is representative of such practices in any year. While individual refineries may change practices in any given year, the overall pattern of these practices, including waste volumes and the potential environmental risks posed, are unlikely to change significantly for the industry as a whole.

Comment 3: In addition, the commenter noted that the volumes do not reflect either the actual or potential co-disposal of the wastes included in EPA's data base, or co-disposal with other refinery wastes managed at onsite and offsite units receiving refinery wastes. Instead, EPA has modeled the factually false and completely unrealistic scenario of forever fixed 1992 volumes of wastes

managed in units that contain only one of the refinery wastes covered by this rulemaking and nothing else except materials of a completely benign nature. (EDF, 00036; ETC, 00038)

Response: In response to the commenter's concern regarding co-disposal of refinery residuals, EPA has conducted a co-disposal analysis, described in detail in the docket for the April 8, 1997, NODA. The universe of residuals considered in this analysis included all of the 29 residuals of concern reported in the 1992 survey of petroleum refineries. For example, in assessing the landfills reported to be used for management of crude oil tank sediment, EPA also compiled the volumes of CSO sediment and other residuals of concern that were reported to be co-disposed with these wastes. While other residuals are generated by refineries, they were assumed to not be of concern to the co-disposal scenario because (1) they are already listed as hazardous (i.e., the wastewater treatment residuals covered by the existing K and F listings), or (2) they were low toxicity residuals not included in the consent decree list of 29 residuals of concern. For off-site disposal scenarios it was not possible to determine what non-refinery wastes could be co-disposed with the residuals of concern. From the data set of refinery residuals for which the Agency had data, EPA eliminated those wastes promulgated as hazardous listed waste through this rulemaking because they will no longer be eligible for Subtitle D disposal.

EPA evaluated those co-disposal scenarios reported in the 3007 survey, focussing on risks associated with benzene for the ground-water scenarios and PAHs for indirect pathways because of their prevalence in the residuals of concern and in the risk analyses as constituents that frequently posed risk. The modeling efforts evaluated the sets of wastes actually reported to be co-disposed. The specific details of the analysis methodologies are presented in the revised indirect and ground-water risk assessment background documents made available for public comment by the NODA.

The co-disposal analyses was described in detail in the Supplemental Background Document for the NonGroundwater Risk Assessment; Interim Notice of Data Availability. This analysis showed no high end risk greater than 1×10^{-6} for any co-disposal scenario or any management unit for risk through NonGroundwater pathways.

(Further responses to comments on co-disposal for the NODA are provided in the response to comment document on the NODA, Section I.A.3)

Comment 4: As a legal matter, EPA's forever fixed 1992 volume and waste management assumptions, and the failure to consider actual or potential co-disposal of wastes in petroleum refinery waste management units, violate Section 1004(5) of RCRA, which defines "hazardous waste" as wastes posing a present or <u>potential</u> hazard to human health and the environment based upon quantity and other factors. Similarly, the methodology violates EPA's criteria for listing determinations, which requires an assessment of "plausible types of improper management". (EDF, 00036)

Response: EPA disagrees with the commenter. EPA considered several criteria to selecting the management practices of concern. The primary criteria was an assessment of whether the practices reported in 1992 were expected to be typical of industry practices and were likely to be similar in subsequent years. In virtually all cases, the Agency concluded that 1992 was a representative year, during which the economy was stable, the industry was operating at high capacity, and many capital changes in response to environmental regulations were already in place (and thus would not result in significant waste generation changes in the future). However, in the case of the spent hydrotreating and hydrorefining catalysts, the Agency did consider the potential effect of "no list" determinations on current recycling practices as a result of discussion with catalyst recyclers and evaluated a scenario where all of the residual volumes would be landfilled.[75] Also see response to Comment 2 in this section.

Further, EPA's approach does assess "present or potential" hazard by virtue of the conservative nature of its modeling approach. The Agency, of course, cannot know for certain what will occur, but tries to make a reasonable attempt to consider potential risks through the conservative assumptions. A summary of the conservative nature of the Agency's evaluation follows. For each scenario modeled, the full range of wastes reported to be subjected to that type of waste management (e.g., landfilling or land treatment) was included in the distribution of wastes of concern. For the indirect pathways, the 2-high end risk assessment methodology used 90th percentile values for those scenarios where volume was selected as one of the high end parameters[76]. The ground-water pathway, as described in the April 8, 1997 NODA, was based on a 2-high end methodology, as well as a Monte Carlo analysis that drew from the full range of reported waste volumes. Thus, the Agency's analysis considers "present hazard" by using characterizations of wastes and management units associated with the scenarios of concern as reported in 1992, and considers "potential hazard" by the evaluation of the 90th percentile volumes in the indirect pathway analysis and the full range of factors affecting releases in the ground-water pathway analysis.

Comment 5: The methodology is also inconsistent with previous Agency practice and policy. According to EPA's recently described listing determination policy, management scenarios "need not be in use currently to be considered plausible by EPA since disposal practices can and do change over time. Potential future waste management practices are projected and considered in the risk analysis, if appropriate." Thus, in the recently finalized carbamates listing, EPA computed landfill waste volumes according to the quantity of wastes that could be landfilled, not just the quantity that happened to be landfilled in the reporting year. Similarly, EPA considered the co-disposal of solvents and other oily wastes in petroleum refining waste management units as part of

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[75]See the 1995 Listing Background Document for the 1992-1996 Petroleum Refining Listing Determination at page 78 and further discussion in comment 5 of this section.

[76]See the 1995 Assessments of Risks from the Management of Petroleum Refining Waste: Background Document for a complete description of the risk assessment methodology and definition of terms.

its 1990 listing determination for wastewater treatment sludges. This inconsistency with previous practice had significant impacts on the modeling results.

The commenter gave specific examples:

- EPA incorrectly chose the "high end" waste volumes for on- and offsite land treatment units. This is because the Agency picked the high end volumes only from those volumes that, in fact, were land treated in 1992. Larger generators landfilled much higher volumes. Since there would be no legal barrier to landtreating these landfilled wastes in the absence of a hazardous waste listing, EPA should have chosen the landfilled volumes as the high end waste volume. This would have resulted in increases in land treatment volumes ranging from factors of 3 (for HF alkylation sludge) to 21 (for crude oil tank sludge).[77]

- EPA did not consider the numerous examples of actual co-disposal of individual petroleum waste streams in the 1992 database and the potential for such co-disposal. For example the vast majority of on site land treatment units and nonhazardous landfills received more than one type of refinery waste. EPA should have factored the combined waste volumes into its high end values. The same is true for off-site facilities, which received multiple wastes from the same facility or wastes from several refineries.

- Further, EPA did not consider codisposal effects based on data, from the Toxic Release Inventory (TRI), compiled under the Emergency Planning and Community Right to Know Act (EPCRA), and other sources, which show codisposal with non-refinery wastes. (EDF, 00036)

Response: The commenter's complaint regarding inconsistency with previous listing determinations does not take into consideration the evolving nature of the Agency's risk assessment process and policies and the significant differences between the industries of concern. The risk assessment for the petroleum refining listing determination is consistent with current risks assessment policy and addresses all significant mismanagement scenarios. (Memorandum from F.H. Habicht, EPA, "Guidance on Risk Characterization for Risk Managers and Risk Assessors," February 26, 1992; and F. Hansen, EPA, "Use of Probabilistic Techniques (Including Monte Carlo Analysis) in Risk Assessment," May 15, 1997)

The commenter compared the approach to developing the distribution of waste volumes landfilled for the carbamates listing determination ("EPA computed landfill waste volumes according to the quantity of wastes that could be landfilled") to that used for the petroleum refining determination ("the quantity that happened to be landfilled in the reporting year"). EPA disagrees with the

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[77]Nor can EPA justify different volumes for onsite and offsite land treatment, since wastes currently managed onsite may be managed offsite at some future time and vice versa. Once onsite and offsite land treatment or landfilling is established as a plausible mismanagement scenario, EPA must assume the same wastes can be managed either onsite or offsite, absent some extraordinary reason related to facility space or regulatory constraints.

commenter's characterization of the Agency's approach to the petroleum refining residual risk assessment. Specifically, as discussed in the 1995 Listing Background Document, waste volume distributions were modified from the 1992 data set in limited cases such as when potential trends in management shifts were identified (such as the catalyst recycling to landfilling scenario). EPA also disagrees with the commenter's underlying assertion that diverse industries should be modeled identically, particularly when the risk assessments of the two industries were conducted at different times, between which policies evolved and court decisions (Dithiocarbamate Task Force v. EPA, discussed in 62 FR 32975, June 17, 1997) altered previously accepted methodologies.

The carbamate and petroleum industries are fundamentally different in their size and degrees of homogeneity. These differences had some effect on the differences in the Agency's approach to identifying management scenarios of concern for these two industries. The petroleum refining industry consisted of 185 facilities in 1992, while the carbamates industry was much smaller and only comprised 23 facilities. The carbamates industry actually was subdivided further into manufacturers of carbamates/carbamoyl oximes (8 facilities), thiocarbamates (1 facility), and dithiocarbamates (14 facilities) that generated the specific wastes of concern for this industry. The large number of refineries provided a much broader distribution of management practices, allowing EPA to rely on actual practices reported and not requiring extensive consideration of practices not reported.

While EPA believed that the sheer size of the petroleum refining industry provided a representative characterization of reasonable management scenarios, the 1992 distribution of management practices was not the Agency's sole consideration in selecting management practices of concern. Prior to the proposal, EPA also evaluated the reported distribution of management practices to ascertain whether additional practices were likely. The express purpose of this exercise was to identify "potential" plausible management practices that were not reported in 1992. As a result of this evaluation, EPA added several scenarios to its risk assessment supporting the proposed rule[78]:

- For FCC catalyst and fines, a monofill scenario was added. The questionnaire was not designed in a fashion that allowed EPA to determine whether landfills were in fact monofills. EPA, however, observed during the field study that some refineries did segregate this waste in monofills or discrete cells to allow for potential future recycling for its aluminum content. A bounding monofill scenario was evaluated for FCC fines, showing no significant risk associated with this material.[79]

[78]See the 1995 Listing Background Document for the 1992-1996 Petroleum Refining Listing Determination, subsections "Management Practices Targeted for Risk Assessment" provided in each chapter.

[79]1995 Assessments of Risks from the Management of Petroleum Refining Waste: Background Document, pp. 12-3 through 12-5.

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- For hydrotreating, hydrorefining and tail gas treating catalysts, EPA evaluated a scenario where all the residual volumes would be landfilled. This was done for two reasons. First, both refineries and catalyst recyclers indicate that management practices change over time. For example, one refinery sent its hydroprocessing catalyst to metals reclamation or to a special waste landfill depending on market conditions (95-PRLP-S0041, page 11), while a catalyst recycler reports that greater quantities of spent catalyst are recycled when metals prices are high, translating to lower costs for catalyst reclamation (95-PRLP-S0057, page 6). Secondly, discussions with other refineries have indicated that they recycle due to corporate policy. If these wastes were to be "stamped" as non-hazardous as a result of a no-list rulemaking, the liability concerns of the refineries might have been somewhat mitigated, reducing their incentives to recycle and increasing their reliance on more cost-effective landfilling options. For these two reasons, EPA therefore considered a hypothetical scenario where all of these catalysts would be landfilled.

In a limited number of cases, management practices were reported by a very small number of refineries that were not explicitly modeled. The commenter noted these scenarios, as discussed further in Section IV of this document on a waste-by-waste basis. For these practices, EPA considered a number of other factors, including the volume of waste involved (e.g., very small volumes were assumed to be insignificant when much larger volumes were otherwise land disposed and modeled), the frequency of the practice (e.g., one-time practices were assumed to be insignificant), and the likelihood that other modeled practices would approximate the potential risks associated with the practice of concern (e.g., use as a landfill daily cover is comparable to landfilling).[80]

The commenter provided a number of examples of wastes where the high end waste volumes for land treatment exceeded the high end volumes for landfilling, and argued that the volumes used in the landfilling assessment were therefore too small. EPA agrees that management practices may shift somewhat from year to year as management units close and open, and as a result of the variability which the wastes may exhibit. However, EPA continues to argue that the approach taken, using 1992 as a baseline year, is valid. 1992 is a valid representation of refinery practices, and while some generators may change practices in any given year, EPA cannot easily project such changes, and volumes going to different management practices could decrease as well.

The commenter also argued that EPA was inconsistent with past listing determinations because "EPA considered the co-disposal of solvents and other oily wastes in petroleum refining waste management units as part of its 1990 listing determination for wastewater treatment sludges." The Agency's response to this concern is provided in Section III.H, Comment 2, part 4.a.

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[80]1995 Listing Background Document for the 1992-1996 Petroleum Refining Listing Determination, page 28.

In response to the commenter's concern regarding the transferability of wastes between land treatment and landfilling, a refinery may choose different disposal practices based on a variety of considerations, two of which are particularly important. First, the refinery must consider the waste's characteristics. Wastes with higher liquid content are more likely to be land treated due to the moisture requirements of the land treatment process, while dewatered wastes are more likely to be landfilled due to cost and waste volume constraints (e.g., more waste costs more). This is supported by the data in the 1992 Petroleum Refining data base as illustrated below in Table III.I-1.

Table III.I-1. Parameters Affecting Transferability of Petroleum Wastes				
	Oil & Grease (%)	% Water	% Organic Liquid	% Solid
All Land Treated Residuals				
Average	13.8	17.2	9.1	76.9
50th Percentile	5	2	0	96
90th Percentile	30.7	50	31.2	100
All Landfilled Residuals				
Average	5.9	7.5	4.2	91.6
50th Percentile	1	0	0	100
90th Percentile	18	25	10	100

These findings may explain why the volume distributions for land treated wastes appear to result in higher 50th and/or 90th percentile volumes than those identified for landfilling (i.e., these wastes contain more oil and more water). In addition, these findings indicate that waste characteristic (oil and water content) are correlated to refinery waste management choices. EPA believes that transferability between management practices is likely to be limited by these waste characteristics.

The second important consideration regarding the transferability of wastes between landfills and land treatment units is that land treatment is a rather limited and specialized management practice, particularly with respect to Subtitle D units. As described in the docket to the April 8, 1997 docket, EPA's database only identified one facility with a co-located on-site landfill and land treatment unit (see S0021, p. 15) and only 6 non-hazardous land treatment units (ibid., p. 30).

Thus, to project that large volumes of waste would shift between landfills and land treatment unit seems implausible. Any changes that do occur in future years are likely to be offsetting given the size of the industry and the lack of identified trends toward any given management practice. Assuming for the sake of argument that such shifts did occur, it is possible that any change in

waste management practice for one refinery would be offset by the opposite change by another refinery, in effect balancing out any changes from year to year.

As discussed above in Comment 3, EPA has evaluated the potential effect of co-disposal to respond to the commenter's concerns. After removing the wastes with listings promulgated under this action, the residual effect of co-disposal appears to be negligible.

The commenter uses the TRI data base to predict cosolvency by citing the quantities of benzene, toluene, ethyl benzene, and xylene released to the land by two refineries. EPA does not find this argument convincing that co-solvent effects are significant at refineries. First, EPA notes that the TRI reporting form specifies that "quantities reported on the Form should ... not reflect the total quantity of waste or constituents of the waste that are not subject to reporting requirements."[81] In other words, the reported quantities are the environmental loadings of the chemical components in land disposed wastes and do not reflect the total quantity of the waste itself. Since these chemicals were managed in onsite Subtitle D landfills (according to the RCRA §3007 survey), they must have been components of wastes that did not exceed the TC criteria. The concentration of these constituents therefore must have been in the part per billion range. (The ppb concentration range was confirmed by dividing the TRI loadings by the total quantity disposed of onsite in 1992 as reported in the §3007 survey.) Therefore, since these "solvent-type" chemicals would be only a very small component of the waste, their cosolvency properties would be extremely minimal if existent. Co-solvency effects are discussed further in this document in Section III.H, Comment 2.

Comment 6: The importance of considering co-disposal of multiple wastes in EPA's data base, and/or other wastes with significant oil/solvent content or containing high concentrations of hazardous constituents, is twofold. First, the information supports EPA's position in 1990 and heretofore completely ignored in the instant rulemaking that co-disposal with wastes producing cosolvency effects in a refinery waste land disposal unit is a plausible mismanagement scenario... Second, EPA's assumption that the other wastes in the modeled land disposal unit do not contain similar or elevated concentrations of the same hazardous constituents belies an actual and potential mismanagement scenario of great concern. (EDF, 00036)

Response: As discussed above in Comment 3, the Agency has attempted to analyze the potential effects of co-disposal. The results of this analysis, further described in the April 8 NODA, show an insignificant level of risk as a result of co-disposal of refinery wastes. As discussed in Section III.H, Comment 2, EPA does not believe these wastes pose a risk of accelerated leaching due to co-solvent effects during co-disposal: (1) all analyses indicated that the TCLP provided an adequate measure of leaching, (2) the wastes of concern do not exhibit multi phase flow, and (3) residuals that are land disposed tend to contain relatively low levels of oil.

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[81]Estimating Releases and Waste-Treatment Efficiencies for the Toxic Release Inventory Form. EPA. December 1987, page 24.

At the time the F037/F038 listings were being developed and the Agency was conducting its field sampling to support that rule, the TCLP was under development. The TCLP was not promulgated as a regulatory tool until March 29, 1990. The F037/F038 sampling and analysis program was largely completed by November, 1990 and the listings were proposed and promulgated, using the risk assessment tools available at that time, without the need for reliance upon a leaching method for organic constituents. EPA has since gained considerable experience with the application of the TCLP, and while it is not perfect, the analyses described in Section H of this document support EPA's conclusion that the TCLP is an adequate tool for predicting leaching from the listing residuals of concern.

With respect to the groundwater codisposal modeled for the April 8, 1997 NODA analysis[82], volumes of all 29 petroleum wastestreams (both study and listing wastestreams) were summed for each landfill based on actual 1992 disposal as reported in the 1992 RCRA §3007 Survey responses. Results showed that although the total waste fraction increases due to codisposal, the effective leachate concentration and total waste concentration for a particular contaminant decrease. As a consequence, individual single-waste stream scenarios were actually more conservative for many wastestreams. The use of a uniform waste fraction of 1.0 for all wastes (i.e., assuming a monofill scenario for each residual) would have been overly conservative and would not have been representative of actual waste disposal as reported in the 1992 RCRA §3007 Survey responses.

Comment 7: In the instant rulemaking, the high-end analysis for the groundwater pathway uses a waste fraction calculated from the 90th percentile 20-year waste quantity <u>for individual waste streams</u> divided by the mean landfill volume. For all but four of the waste streams, the calculated waste fraction is at least an order of magnitude less than the <u>minimum</u> value of 0.036 recommended in the user's guide for the model, based upon the assumption that the receiving unit contains a minimum of 3.6% hazardous material. (EDF, 00036)

Response: The minimum value of 0.036 reported in the EPACMTP 1995 User's Guide is a lower bound obtained from an analysis of waste composition in municipal landfills[83] and its use as a lower bound applies only to the database used for HWIR modeling. Waste fraction is dependent on both waste quantity disposed and unit size, as the commenter implies. The RCRA §3007 survey provides reliable data for waste quantity and onsite unit area, while the suitability and source of offsite unit areas is discussed elsewhere in these comments (i.e., Section III.J). These input data are specific to the industry under study. In contrast, the minimum waste fraction data cited by the commenter and used for HWIR is based on an analysis of waste composition to municipal waste landfills (as stated in the EPACMTP User's Guide). In summary, the derived

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[82]Supplemental Background Document, Groundwater Pathway Risk Analysis, Petroleum Refining Process Waste Listing Determination. 1997

[83]Scats, R. and Salhotra, 1992. Subtitle D (Municipal) Landfill Characteristics. Center for modeling and risk assessment, Woodward-Clyde Consultants, Oakland CA.

waste fraction value used for refining wastes is more appropriate than the HWIR value because (1) it is derived from refining industry-specific data rather than the more general data used for HWIR, and (2) it represents a different disposal assumption than that used for HWIR (i.e., refinery wastes are assumed to be continued to be disposed in Subtitle D landfills, while in HWIR formerly hazardous wastes are assumed to be disposed in Subtitle D landfills.

Comment 8: EPA presented no sound technical basis for its selection of a waste fraction value in the groundwater model. The value EPA uses is arbitrary and results in unreasonably high modeled receptor well concentration in their high-end risk evaluation. The rationale for calculating the waste fraction appears to be arbitrary. The waste fraction is directly dependent on the landfill area. It is illogical to fix the waste fraction to a "desirable" level first and then disregard this dependent nature when performing subsequent "sensitivity" analyses. If the EPA wishes to use the high-end area in its high-end analysis, it should calculate the waste fraction from the high-end waste stream volume and landfill volume. (Shell, 00047)

Response: The Agency recognizes the commenter's concern regarding the values of waste fraction and the two high-end parameter and central tendency groundwater pathway modeling have been re-evaluated in the current analysis to reflect the disposal of actual waste quantities and waste unit volumes as reported in the 1992 RCRA §3007 Survey. The volumes of each waste stream in the current analyses were set as constant values equal to the (1992 reported waste volume) (20 years) in the EPACMTP input files, rather than as derived variables as in the 1995 analyses. The details and results of that analysis are presented in the docket to the April 8, 1997 NODA.[84]

J.   WASTE UNIT AREA

Comment 1: EPA diverted from past practice and used modeling assumptions, in the groundwater model, that cannot be supported by present or potential waste management practices for waste unit area. The larger the waste unit area, the higher the resulting concentration at the receptor well for aqueous phased contaminant transport. The methodology at best reports a snapshot of landfill sizes in 1992 by waste stream, and completely ignores the potential for any nonhazardous refinery waste to be managed in any onsite nonhazardous landfill now or in the future. Therefore, the fact that FCC catalysts or HF alkylation sludge were managed in smaller onsite landfills in 1992 does not preclude refineries from disposing of these wastes or others in the larger units that obviously exist at many refineries. There is no legal or other impediment to such disposal, and therefore must be considered a plausible waste management scenario. (EDF, 00036)

Response: The Agency recognizes the commenter's concern for the accuracy of the data used in the modeling analysis. The waste quantity and onsite landfill sizes used in the modeling analysis

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[84]Supplemental Background Document, Groundwater Pathway Risk Analysis, Petroleum Refining Process Waste Listing Determination. 1997.

for individual wastestreams were from the RCRA §3007 Survey responses and were, therefore, based on actual petroleum waste management practices in 1992. Assumptions were not made in the modeling analyses about potential disposal practices other than those reported in the RCRA §3007 Survey responses. Offsite landfill sizes were selected from the USEPA's Database of Industrial Subtitle D Landfills[85] and were reasonable estimates based on available information. Furthermore, for finite waste sources, it is not necessarily true that the larger the landfill, the higher the resulting receptor well concentration. The modeled receptor well concentration is a function of a number of parameters, such as waste volume, leachate concentration, and various chemical transport properties. For a given waste volume, a larger landfill area will not necessarily produce higher well concentrations.

EPA believes that there are indeed reasons why a facility would not dispose all its generated waste in an onsite landfill, including permit limitations and liability considerations. Based on its review of engineering site visit reports, EPA found that four facilities operated onsite nonhazardous landfills. Two facilities manage FCC catalyst and fines, but no other listing or study wastes, in their landfills. The two other refineries operate onsite nonhazardous landfills for disposal of only some of their generated wastes; other wastes are disposed offsite or recycled. EPA believes its approach of calculating different unit areas for different wastes was reasonable because they are reflective of actual operating practices, and another approach may result in unrealistic or unreasonable assumptions regarding waste management practices.

Comment 2: The methodology employed for deriving high-end waste unit areas ignores the present and potential co-disposal of refinery wastes in onsite facilities. EPA's underlying assumption that some refinery wastes will not be managed in the larger landfills sharply contrasts with the reality that onsite refinery landfills routinely receive refinery wastes of all kinds. (EDF, 00036)

Response: The Agency recognizes the commenter's concern for the representativeness of the modeling scenarios. In response to the above and several other comments regarding codisposal practices, on- and off-site codisposal modeling scenarios were included in the April 8, 1997 NODA analysis[86]. It should be noted, however, that landfill areas are not a sensitive parameter in consideration of codisposal. Total waste volume and/or mass is the parameter that could possibly produce higher risk in a codisposal scenario. As discussed above, for a given waste volume, a larger landfill area will not necessarily produce higher concentrations at receptor wells.

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[85]U.S. EPA. Background document for EPACMTP: Finite Source Methodology for Degrading Chemicals with Transformation Products. 1996.

[86]Supplemental Background Document, Groundwater Pathway Risk Analysis, Petroleum Refining Process Waste Listing Determination. 1997.

Comment 3: The same error (but smaller in size) applies to waste unit area sizes for onsite land treatment units in the instant rulemaking. High end on-site facility values range from 130,714 square feet to 688,000 square feet and, thus vary by a factor of over five. (EDF, 00036)

Response: High-end waste unit area (90th) percentiles for various wastestreams, were used for land treatment modeling in the 1995 groundwater pathway analyses. The 90th percentile onsite land treatment unit areas were based on actual waste disposal data reported in the RCRA §3007 Survey data for onsite land treatment units and ranged from 130,714 <u>square meters</u> to 688,000 <u>square meters</u> (not square feet).

Comment 4: EPA diverged from previous listing determination methodologies without justification or explanation. In the carbamates listing determination, one landfill size was set for both onsite and offsite landfilling, based upon the total quantity of carbamate waste requiring disposal. While EPA wisely chose only one size for offsite landfills, the size of the landfill is inexplicably small given the corresponding value in the carbamates rulemaking. Since the size of offsite facilities should not be industrial sector dependent, EPA cannot artificially create an assumption that refinery wastes will be managed in offsite landfills almost one-sixth the size of offsite landfills receiving carbamate wastes. (EDF, 00036)

Response: Given the size of the petroleum refining industry, geographic distribution and number of facilities, EPA could not assume that all refinery wastes would be disposed in the same landfill. However, where multiple wastes generated by one refinery within a residual category of concern were co-disposed in a given unit, EPA considered the total volume of that refinery's waste in the risk assessment supporting the proposed rule. Similarly, volumes of wastes within the same residual category that were managed in the same off-site facility, regardless of the number of refineries generating the wastes, were combined. For the risk assessment supporting the final rule, the co-disposal scenario (described further in Section III.I, Comment 3) considered the impact of managing multiple residual categories in the same management units.

With regard to the commenter's comparison of the landfill sizes used for the petroleum refining and carbamates listing determinations, the Agency refers the commenter to Section III.I, Comment 5 regarding the inherent differences between these industries and the manner in which their wastes are generated. As noted above, it would be unrealistic to assume all petroleum wastes generated by over 170 facilities would be disposed in one large off-site landfill. EPA's methodologies for risk assessment have evolved since the promulgation of the carbamates listing, and EPA believes that the approach used in the current petroleum listing is a more accurate.

The median and high-end waste unit areas used in the two high-end parameter analysis were derived from the industrial subtitle D landfill survey database; however, the median landfill area was incorrectly interpreted to be 2,020 square meters, when in fact it should have been 20,200 square meters. The high-end landfill area of 162,000 was correctly represented in the analysis. The Agency has conducted revised two high-end parameter modeling analyses with a median landfill area of 20,200 meters. The Agency has also expanded the analysis to also include

municipal landfill area distributions. The revised and expanded analyses are presented in "Additional Groundwater Pathway Analyses; Supplemental Background Document; Petroleum Refining Process Waste Listing Determination, USEPA, " 1998.

The off-site landfills used in the revised groundwater risk were derived from EPA's 1988 Survey of Municipal Landfills.[87] The high end area (90th percentile) used was 420,888 square meters. This is somewhat smaller than the high-end area assumed by EPA in its analysis for the carbamate listing, which was 949,317 square meters. EPA believes that the areas used in the present rulemaking are more realistic in that they are derived from actual landfill data. The area used in the carbamates rule was simply projected from the total volume of all carbamate wastes. Furthermore, the full distribution of unit areas from surveys of off-site landfills were used in the Monte Carlo assessment of the potential risks associated with off-site landfilling. Thus, EPA believes that its approach in the current rule represents the evolution of risk assessment methodology.

Comment 5: In selecting a plausible mismanagement scenario for dissolved phase contaminant flow, EPA should develop a volume size that reflects the quantity of <u>all refinery wastes that could be landfilled over the unit's active life,</u> taking into account the potential for co-disposal of other wastes in these units. (EDF, 00036)

Response: The co-disposal scenario considers the volumes of the 29 residuals of concern identified in the EDF/EPA consent decree (see Section III.I, Comment 3). EPA did not collect information regarding the composition or volumes of other refinery residuals.

For the Groundwater Pathway Analysis, an active landfill lifetime of 20 years was assumed (see Section III.L). Therefore, a total 20-year volume of waste was modeled for each single wastestream scenario conducted in the 1995 analysis as well as for the single-wastestream and codisposal scenarios conducted for the April 8, 1997 NODA. The codisposal scenario is included in the current analysis in response to several comments. EPA notes, however, that it revised its assumption of active landfill life to 30 years for off-site units, as described in the response to comments document for the NODA (see Section I.A of that document).

See also responses to comments 1, 2, and 3 in this section, above for additional responses on the issue of co-disposal.

K.   POTENTIAL FOR FREE-PHASE FLOW

Comment 1: EPA's modeling analysis of groundwater exposure concentration inappropriately discounts the potential for migration of nonaqueous-phase liquids to the groundwater zone

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[87]Draft National Survey of Solid Waste (Municipal) Landfill Facilities, EPA/530-SW-88-034, US EPA, 1988.

beneath the waste units. An evaluation of the potential for multi-phase transport fails to recognize that the mechanisms governing NAPL transport are different from those that govern aqueous-phase transport, so the parameters controlling NAPL releases are also different. Therefore, EPA's evaluation compares the results of two models (EPACMOW and EPACMTP) at the receptor well for a waste management scenario in which conditions are <u>unfavorable</u> for NAPL transport, and thus not an appropriate plausible mismanagement scenario for the evaluation. (EDF, 00036)

Response: EPA maintains that its multi-phase analysis did recognize that the mechanisms governing NAPL transport are different. A multi-phase flow and transport code, EPACMOW[88], was selected specifically to account for oily phase flow mechanisms. Furthermore, as discussed in detail in Section III.H of this response to comment document, EPA conducted additional laboratory analyses of the residuals of concern. EPA's contract laboratory did not observe any samples of the listing residuals that were multiphasic or heterogeneous. In no cases was the laboratory able to generate an oily filtrate. EPA contends that the residuals of concern are not oily in the manner anticipated by the commenter. For example, these materials differ dramatically from used oil which is essentially all oil. Crude oil tank sediment, the "oiliest" of all the residuals of concern, was never observed by the Agency during sampling and analysis to exhibit an oily phase. These materials were generally solid at room temperature, with a tarry or granular consistency. Upon further review of the database, the high values quoted by the commenter of 80 percent oil content (figure cited in the original comment) was determined to be a coding error, reflecting oil content in one residual prior to oil recovery, which reduced the oil content dramatically. The Agency continues to believe that the "oil content" of 27 percent assumed by the Agency in its assessment of free phase flow is appropriate both in terms of actual reported values in the survey and of the Agency's observations during sampling and analysis.

The Agency's analysis assumed a waste free oil content of 27 percent for its initial calculations, based on data from the Questionnaire, which is more realistic than a value of 80 percent cited by the commenter. This is because the 80% value resulted from an error in reporting (see Supplemental Background Document-Listing Support Analyses; Petroleum Refining Process Waste Listing Determination, March 1997 in the docket, Appendix A). The Agency used EPA's Composite Model for Oily Waste (EPACMOW), which accounts for both aqueous phase and non-aqueous phase flow and transport, to estimate constituent transport. High end parameters were chosen for sensitive parameters (landfill area, waste quantity, waste fraction, constituent concentration, and infiltration rate). Thus, even assuming the oil fraction is free to migrate, the model predicted no release of NAPL from the landfill, because there is not sufficient oil to saturate the material in the landfill beyond the 10% residual saturation limit. Below this limit the oil will not migrate as a NAPL. If the oil does not escape the landfill, the NAPL cannot saturate the soil beneath the landfill, nor can NAPL-facilitated transport in the subsurface occur.

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[88]U.S. EPA. "EPACMOW: EPA's Composite Model for Oily Waste Version 1.0, Documentation and User's Guide." 1995.

Beyond the results of the EPACMOW, EPA believes the commenter's concerns about NAPL or free-oil release from landfills are unwarranted, since the residuals of concern are not oily in the manner anticipated by the commenter. While the sampled residuals may contain oil, this observation is not equivalent with concluding, as the commenter does, that free oil is present in these residuals. The method used to estimate oil content in the samples, the Total Oil and Grease (TOG) method, will overestimate "free" oil because it uses a strong organic solvent to extract various organic material, including waxes, greases, and higher molecular weight oils that are not mobile. During EPA's observation and handling of crude oil tank sediment during sampling and laboratory analysis, a discrete oily phase, or NAPL, was not observed. None of the samples analyzed via the TCLP in this investigation were found to have oily phases. In addition, as noted elsewhere, reported oil and grease content of landfilled wastes support EPA's conclusion that wastes with high oil content (whether free oil or not) are not typically land disposed. This result is consistent with EPA's belief that oil concentrations in a landfill will not reach the levels the commenter suggested, since refineries have economic incentives to recover free oil as much as possible, and minimize the amount of recoverable oil that is disposed in residual material.

Comment 2: EPA's dismissal of the possibility of NAPL migration to the water table has a domino effect in that, based on its analysis of multi-phase transport in the soil zone, EPA chooses to forego an evaluation of the impact of saturated-zone NAPL on receptor well concentrations. (EDF, 00036)

Response: EPA has concluded that the NAPL flow, if any, from these residuals will not reach the underlying aquifer and thus further modeling is not necessary. As discussed in Section III.H, the Agency has no information that indicates that the residuals of concern are likely to exhibit free phase flow.

Comment 3: EPA concludes that the NAPL will not exit the base of the landfill because the fraction of oily liquid in the waste unit is so small that all of the oil will be retained in the waste unit as immobile residual. The basis for this conclusion is a calculation indicating that the fraction of the landfill occupied by the NAPL will be only 0.00387 percent.

The fraction of NAPL in the landfill is calculated by dividing the 20-yr 90th percentile crude oil tank sludge waste stream volume by the 90th percentile landfill volume and taking 27% of the resulting waste fraction. This combination of parameters does <u>not</u> represent a high-end scenario for NAPL release.

For example, in evaluating the potential for NAPL release, <u>a smaller landfill</u> provides the reasonable worst-case management scenario, because the potential for NAPL release increases with the waste fraction as explained below. Since there is no legal or technical bar precluding the disposal of substantial waste volumes in small landfills (other than exceeding the capacity of the landfill), disposal of the wastes in a smaller landfill is a more appropriate, plausible mismanagement scenario for considering the potential for NAPL release. Indeed, the evaluation

of different landfills for aqueous and free phase flow is required where different landfills reflect reasonable worst case mismanagement scenarios.

Given the waste unit characteristics provided in EPA's multi-phase transport analysis, the maximum fraction of NAPL the landfill can retain is 0.045. A NAPL fraction exceeding this value will produce a release of crude oil from the unit.

In the 50th percentile off-site landfill, which has a volume of 5,252 cubic meters, the 0.045 threshold oil fraction will be exceeded if a quantity of crude oil tank sludge greater than 51 MT/yr is placed in the unit. The average waste quantity reported in 1992 for disposal of this waste offsite in a nonhazardous waste landfill was 123 MT, indicating that NAPL release from the 50% offsite landfill is a plausible mismanagement scenario, without even considering the potential for codisposal.[89] (EDF, 00036)

Response: The free-phase flow scenario was performed with waste unit area, waste unit thickness, infiltration rate, leachate concentration (TCLP) and bulk waste density, set to their high end (90th percentile) values. Therefore the scenario is already more than a two high-end parameter scenario even though the fraction of NAPL in the landfill was calculated by dividing the 20-yr 90th percentile crude oil tank sludge wastestream volume by the 90th percentile landfill volume resulting in a less than 90th percentile waste fraction. Furthermore, as discussed in response to Comment 1 above, EPA contends that the residuals of concern are not oily in the manner anticipated by the commenter, and analysis showed that these materials were generally solid at room temperature, with a tarry or granular consistency. Therefore, the question of whether a larger quantity of "oil" in the landfill should have been modeled is not an issue.

The 27% oil and grease value cannot, in realistic terms, be assumed to be free oil, but in actuality consists of a variety of materials which are tarry and immobile. The analysis referred to by the commenter is extremely conservative because it assumed that the 27 percent value was all free oil, while EPA's observations of these wastes indicates that very little, if any, of the total oil and grease in crude oil tank sediment is actually free to migrate.

Comment 4: EPA falsely assumes the percentage of oil in COST sludge will never rise above the 27%. (EDF, 00036)

Response: As discussed previously above in Comment 1 and in Section III.H, EPA does not believe that these wastes will generally contain significant levels of mobile oil, particularly when evaluated after de-oiling or when focussing on those waste destined for landfilling. Future waste disposal practices are expected to be similar to 1992 disposal practices and the wastes are expected to be similar in nature. Refineries have economic incentives to recover free oil as much as possible and minimize the amount of recoverable oil that is disposed in residual material.

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[89]1995 Listing Background Document at 27.

Again, EPA argues that the 27% value is not relevant and the physical nature of all the crude oil tank sediment samples was such that the percentage of <u>free</u> oil is probably close to zero in all cases.

Comment 5: EPA falsely assumes that the waste will be uniformly mixed with benign material in the landfill. Uniform mixing of the waste is not a plausible mismanagement scenario. It is highly unlikely that the other wastes received by a landfill over its operational period will be benign. The implications for co-disposal for NAPL transport are that the oil-retention capacity of a substantial portion of the landfill matrix will be taken up by co-disposed oils and organic liquids, and free-phase NAPL in the modeled waste stream will be more likely to exit the waste unit. (EDF, 00036)

Response: As discussed in response to Comment 1 above, EPA has further analyzed the residuals of concern and EPA contends that the residuals of concern are not oily in the manner anticipated by the commenter; therefore, any concern over exceeding the residual saturation of the landfill through codisposal with other wastes is unfounded. EPA has no basis for assuming that these wastes, which contain virtually no free oil, will be placed in a landfill with a large amount of free oil which will then mobilize the constituents.

Comment 6: When NAPL enters an unsaturated soil column, vertical migration dominates. For a given volume of mobile NAPL, the smaller the infiltration area, the narrower the soil column through which the NAPL travels, and the less soil volume available for NAPL retention. For the 50th percentile offsite landfill, the unsaturated zone beneath the waste is 6.1 meters thick. Given the previous assumptions about the NAPL, including the holding capacity of the unit itself, the threshold quantity of crude oil storage tank sludge producing NAPL at the water table is 161 MT/yr, or 52% of the landfill volume. (EDF, 00036)

Response: EPA responds to the commenter's concerns of NAPL leaving the landfill in comment 3 above.

Comment 7: Although the thickness of the unsaturated zone did not emerge as a highly sensitive parameter in the analysis of aqueous-phase transport from the modeled waste streams, the distance of the oily waste above the water table is crucial in controlling whether or not NAPL will reach the groundwater zone. In the modeled scenario, the thickness of the unsaturated zone (6.1 m) was determined using the median value from the OSW modeling database. A true high-end analysis of the potential for NAPL migration to ground water would also consider the 10th percentile depth to the water table. (EDF, 00036)

Response: EPA's free-phase modeling analysis showed that none of the oily phase would exit the landfill even if an oil phase existed (which EPA believes is not the case); therefore, the thickness of the unsaturated zone will not be as significant as the commenter suggests. The free-phase flow scenario was performed with waste unit area, waste unit thickness, infiltration rate, leachate concentration (TCLP) and bulk waste density set to their high end values. Therefore the scenario

is already more conservative than a two high-end parameter scenario. The commenter's concerns regarding the unsaturated zone thickness is mitigated by EPA's conclusion that no oily phase would exit the unit.

Comment 8: The NAPL retention capacity of the unsaturated zone affects NAPL migration. The smaller the NAPL retention capacity of a medium through which a NAPL flows, the less volume is left behind as immobile residual, and the more volume that is available to migrate. EPA assumes the unsaturated zone has an oil retention capacity of 26% of the pore space. The origin of this value is a table in Mercer and Cohen (1990) which provides the crude oil holding capacity of a saturated sandstone. In the instant rulemaking, the modeled geological medium is not a sandstone: it is an unconsolidated sandy deposit with characteristics generated by the averaging of nationwide hydrogeological data. Although the Mercer and Cohen (1990) paper does not present a retention capacity for crude oil in unconsolidated deposits, an analogous heavy oil is reported as having a retention capacity of 20% in unsaturated soil. When the EPA Composite Model for Oily Wastes was tested on a crude oil release in an unconsolidated deposit (Bedmiji site), the oil retention capacity was also set at 20% (EPACMOW User's Guide).

A reduction in oil retention capacity to 20% would reduce the threshold quantity of crude oil storage tank sludge causing NAPL migration to groundwater from 161 MT/yr to 136 MT/yr (44% of the landfill volume), or only 13 MT higher than the average quantity reportedly landfilled offsite in 1992, before considering any potential codisposal scenarios. Moreover, this threshold quantity assumes the NAPL migrates as a uniform slug beneath the unit. Under a real landfill, unsaturated soils will contain preferential paths for oil migration. Thus, the actual volume of soil available for oil retention will be substantially smaller, increasing the likelihood that waste management scenarios for the instant rulemaking will generate NAPL sources in the groundwater. (EDF, 00036)

Response: The oil retentive capacity is not a particularly critical issue because, as discussed in Section III.H, EPA contends that the residuals of concern are not oily in the manner anticipated by the commenter and concludes that no oily phase would exit the unit, as discussed in comment 2 above. Finally, EPA maintains the oil retentive capacity of 26% for the soil was a reasonable value to use for the screening analysis in light of the other conservative assumptions used (these assumptions are discussed in response to comment 7 in this section.

EPA's laboratory analysis of the residuals of concern did not show any to contain immiscible phases. These materials were generally solid at room temperature, with a tarry or granular consistency. Therefore the oil retentive capacity of the unsaturated zone beneath the landfill is not an issue. 100% of the solid residuals will be retained by the landfill and contaminants will only be transported in the aqueous phase.

Comment 9: Even if the migrating oil body contains insufficient oil to reach the well in the free phase, the groundwater zone will still contain a zone of laterally distributed immobile residual. This zone of residual can exist substantially beyond the bounds of the landfill in the direction of

groundwater flow, effectively reducing the distance between the "source" and the receptor well. Dilution and attenuation mechanisms in the groundwater become the only controls on receptor well concentrations during the active life of the saturated-zone source. (EDF, 00036)

Response: The basis of the comment is an assumption that free-phase oil will saturate the soil around the landfill. However, both EPA's 1995 free-phase flow modeling analysis and the laboratory analysis described in Section III.H demonstrate that its assessment of the potential for free phase flow was adequate and that these wastes in general should not contain sufficient free oil to exit the landfill, enter the unsaturated zone, and travel to the water table.

The distance between the source and the receptor well will only be reduced if sufficient quantities of free-phase oil are present in the waste. The free-phase flow analysis conducted in 1995 showed that for a multi-high-end (more than two high-end parameters) scenario sufficient oil was not present and more importantly as stated above, EPA's laboratory analysis of the residuals showed that the samples were not multiphasic or heterogeneous. These materials were generally solid at room temperature, with a tarry or granular consistency.

Comment 10: Contaminants flowing from the oil will dissolve into groundwater flowing through the residual zone at their effective solubility levels. Accordingly, the chemical concentration at the groundwater zone will be higher than any scenario modeled in this rulemaking because the contaminant-attenuation capacity of the unsaturated zone column is unavailable. The combination of reduced distance between the receptor well and source, and the higher initial concentrations, can be expected to significantly increase receptor well concentrations. (EDF, 00036, II.E.3.¶23)

Response: EPA fundamentally disagrees with the commenter regarding the presence of free oil in these materials. As stated in response to comments 1 and 7 of this section, EPA does not believe that free oil will exit the waste management unit.

Comment 11: Leachate exiting the base of the landfill is likely to contain oil emulsions because of co-disposal of other wastes. Micro-emulsions increase the effective aqueous solubility of compounds present in the oil, leading to higher chemical concentrations in groundwater near the emulsion. Hydrophobic contaminants such as PAHs will preferentially partition to the oil droplets in micro-emulsions, providing a mechanism for facilitated transport of these compounds. The oil droplets that form micro-emulsions in the groundwater zone tend to travel in the larger pore spaces of a hydro geological medium, so their transport paths are less dispersed than those of compounds dissolved in water. Given the high potential for co-disposal with other refinery and industrial wastes, facilitated transport within micro-emulsions is a plausible mismanagement scenario, as the Agency indicated in 1990. (EDF, 00036)

Response: EPA refers the commenter to NODA Section I.C.1, comment 8, for more detailed comments and response concerning the co-disposal of refinery wastes with other oil bearing wastes.

L.   LANDFILL/SURFACE IMPOUNDMENT ACTIVE LIFE

Comment 1: The commenters object to EPA's assumption that surface impoundments and landfills have only a 20 year active life. There is little or no basis for the 20 year active life assumption. (ETC, 00038; EDF, 00036)

Response: The Agency recognizes the commenter's concern for the representativeness of the landfill scenarios. The 20-year time frame was chosen as representative of the average operational life for a typical landfill where petroleum wastes are disposed. This time period is based on a median active life of petroleum waste landfills[90] and on the average active lifetime of Municipal Subtitle D landfills[91].

EPA reexamined the long-held assumption of 20 year active life based on the OSW's survey of municipal landfills[92] and calculated an average total life of 30 years for offsite units. Revised two high-end parameter analysis were performed for the groundwater pathway analysis for offsite landfill disposal assuming a 30 year active landfill life. The results of that analysis are presented in additional groundwater modeling documents.[93]

For onsite landfills EPA calculated a median active life of 21.5 to 23 years using various methods based on data from the RCRA §3007 Survey responses. Therefore the agency believes that a 20 year active life assumption is valid for onsite units. This issue is discussed further in response to comments on the NODA analysis; see Section I.A.6.b in the NODA response to comments document.

Comment 2: In the carbamates listing determination, EPA assumed a 30 year active life for <u>all</u> landfills and surface impoundments. No explanation is provided as to why carbamate waste facilities are assumed to operate longer than petroleum refinery waste facilities. (EDF, 00036)

Response: EPA conducted a review of the active lives of landfills as reported in the 1992 RCRA §3007 surveys. This review is presented in the Supplemental Background Document for Listing Support Analysis, March 1997. EPA looked only at refinery landfills managing petroleum wastes

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[90]U.S. EPA. Supplemental Background Document; Listing Support Analyses; Petroleum Refining Process Waste Listing Determination, Docket Report. March, 1997.

[91]U.S. EPA. Draft National Survey of Solid Waste (Municipal) Landfill Facilities, EPA/530-SW-88-034. 1988.

[92]U.S. EPA. Draft National Survey of Solid Waste (Municipal) Landfill Facilities, EPA/530-SW-88-034. 1988.

[93]U.S. EPA. "Additional Groundwater Pathway Analysis."; Supplemental Background Document; Petroleum Refining Process Waste Listing Determination, 1998.

of concern. Based on this analysis, EPA determined that the median active life is approximately 20 years. Therefore, EPA is confident that the 20 year value is appropriate for onsite landfills managing petroleum wastes because it is based on industry-specific information.

Also see Response to Comment 1 above.

Comment 3: There is a substantial body of evidence demonstrating many refinery waste management units have extremely long active lives. For example, EPA recently proposed a treatability variance to address sludge from a refinery surface impoundment operating since the late 1940s. In the course of reviewing a very small number of refinery RFAs, EDF found many surface impoundments and landfills operating for longer than 20 years. These data demonstrate the inadequacy of the 20 year active life assumption for refinery waste land disposal units. A plausible mismanagement scenario should take into account the potential for refineries to manage wastes in land disposal units for very long periods of time, as indicated by previous and current practices. (EDF, 00036)

Response: See Response to Comment 1 above. Concerning impoundments, EPA notes that "active life" concept is of limited use in projecting volumes of waste disposed, due to a variety of reasons. First, as noted elsewhere (Section IV.E.2, Comment 1 of this document), most impoundments are part of a wastewater treatment train and do not accept the waste as generated, i.e., waste wasters flow to these impoundments only after some treatment. Other impoundments, as documented in the October 1995 Listing Background Document (page 63) for FCC catalyst fines, are typically used to settle solids from aqueous waste mixtures prior to wastewater treatment. For such settling impoundments, solids that collect in the unit are typically removed periodically for dewatering and disposal, thus waste volumes in such units are difficult to project. EPA believes that the 20-year assumption for on-site impoundments is quite conservative as a basis for estimating the volume of the waste that might be present in the unit. Furthermore, EPA notes that impoundments were modeled only for one waste, FCC catalysts and fines, and the risks for this waste were negligible. Therefore, any changes in assumptions to waste volume in the unit for this waste are unlikely to result in any significant change in risks or alter EPA's decision not to list this waste.

EPA reviewed active lives for onsite landfills managing petroleum refining wastes addressed in the proposed rule, and presented these results in the Supplemental Background Document for Listing Support Analysis, March 1997. EPA found that some facilities have (or are likely to have) landfills with a greater than 20 year active life. At the same time, an equal number of facilities were found to operate landfills for less than 20 years. Therefore, EPA believes that the use of 20 years for landfill active life is appropriate because it represents a median value.

The commenter is also correct in stating that EPA chose not to vary active life, instead using the 50th percentile value throughout its analyses. Such a variation would affect the calculated waste fraction, which is input directly to the model. However, as presented in the Supplemental Background Document for Groundwater Assessment, March 1997, EPA did vary another

parameter affecting waste fraction, namely waste quantity. Setting waste quantity to 90th percentile also increases the calculated waste fraction. Therefore, because waste quantity and active life affect waste fraction, and because EPA has already elected to vary waste quantity, EPA believes it has responded to the commenter's concern of the effect of increasing active life on the modeled results.

M. INDIRECT EXPOSURE MODELING

Comment 1: EPA chose not to consider the results of the listing determination, thereby ignoring potential health effects to subsistence farmers and fishers, ignoring one of the most exposed and vulnerable population groups affected by refinery waste management. (EDF, 00036)

Response: In the proposed listing decision the beef, milk, and fish pathways in the subsistence farmer and fisher scenarios were initially evaluated using beef, milk, and fish biotransfer factors for PAHs that were estimated using the octanol/water partition coefficient (K_{OW}). It is known that these biotransfer factors greatly overestimate the concentration of very hydrophobic constituents with a log K_{OW} greater than 6.5 (Dowdy et al., 1996). In addition, the derivation of these factors using K_{OW} does not account for biochemical processes such as metabolism. There are some empirical data, however, that can be used for the estimation of biotransfer factors for PAHs for fish. The uncertainty associated with biotransfer factors for aquatic organisms are addressed in an analysis that is presented in detail in the Uncertainty Analysis: NonGroundwater Pathway Risk Assessment, 1998.

There are no measured values that can be used to estimate biotransfer factors for beef and dairy for PAHs. Therefore, the remaining alternative is to calculate values for these factors using the K_{OW} or other physical/chemical property to estimate transfer of the constituent from the intestine to fat storage. The method used in the bounding estimates in this analysis conducted for the proposed rule is presented below[94].

$$BCF_{BEEF} = EXP(-7.6 + LOG\ K_{OW})$$

and

$$BCF_{MILK} = EXP(-8.1 + LOG\ K_{OW})$$

where:

BCF_{BEEF}	=	biotransfer factor for beef
K_{OW}	=	octanol-water partition coefficient
BCF_{MILK}	=	biotransfer factor for milk

This relationship is a reasonable prediction for a number of chemicals. It is known that PAH compounds are readily metabolized by mammals by well-developed mixed function oxidase

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[94]C.C. Travis, A.D. Arms, 1988. Bioconcentration of organics in beef, milk, and vegetation. *Environmental Science and Technology*. 12: 533-540.

(MFO) systems[95], meaning that actual BAFs would be much lower than predicted using log K_{OW}. Mammals are capable of metabolizing PAHs even more efficiently than aquatic organisms (Beaulieu, Steve. Personal communication with Lawrence Burkhard, EPA. Memorandum to the file. Research Triangle Institute, RTP, North Carolina. Re: telephone contact, 1997.). As a result, the body burdens estimated using the estimated biotransfer factors based upon these equations represent upper bound screening estimates that could occur only in animals with deficient MFO systems. Therefore, beef, dairy, and fish ingestion pathways are not evaluated in any analysis except for the initial bounding analysis.

Comment 2: EPA's justification for ignoring subsistence farmer and fisher receptors is the "high uncertainty" associated with fish and plant-to-animal bioconcentration factors for the PAHs of concern in this rulemaking. Yet as a condition of obtaining a RCRA permit, EPA currently requires hazardous waste combustors to evaluate the impacts to subsistence farmers and fishers of PAH emissions from their facilities along the very same direct and indirect food chain pathways at issue in the instant rulemaking. Moreover, the HWIR proposal considered potential impacts to subsistence farmers and fishers from releases of PAHs and many other constituents along the same exposure pathways. If EPA assumes PAH bioconcentration factors are a source of uncertainty, EPA cannot then ignore the pathways and risk entirely, thereby de facto assuming the pathways present no risks. Instead, EPA should consider the information qualitatively, and/or present a range of results based upon possible bioconcentration factors. (EDF, 00036)

Response: EPA has not ignored risks to subsistence receptors from indirect exposure to PAHs. Rather, lacking valid quantitative means of estimating biotransfer factors for PAH for beef and dairy, the Agency has relied on qualitative knowledge regarding metabolism of PAHs by mammals. However, no measurement data are available for calculating compound specific bioaccumulation factors for animals. Subsistence fisher scenarios were evaluated using measured bioaccumulation/bioconcentration factors (BAF/BCF) where available. BAFs reflect the transfer of contaminant from the environment to the fish from food sources as well as dissolved concentration (L/kg body weight) total. Since measured BAFs are usually not available BCFs are used. BCFs represent the transfer from the dissolved phase to the fish tissue BCF (L/kg). For those constituents for which neither measured BAFs nor BCFs were available, EPA assumed that BAFs did not exceed 1000 L/kg. This assumption is based on the data presented in Derivation of Proposed Human Health and Wildlife Bioaccumulation Factors for the Great Lakes Initiative (U.S. EPA, 1993). The Agency believed this to be a conservative assumption based on statements in this document that since predicted BAFs for 4 PAHs with three and four rings range from 17 to 228 it is unlikely that PAHs with five rings will have BAFs greater than 1000. While there are insufficient data to define the distributions and correlations needed for a reliable probabilistic analysis of bioaccumulation of PAH's in fish, EPA did conduct a quantitative uncertainty analysis for BAFs using interval analysis. This is an appropriate statistical method for

[95]B.A. Rattner, D.J. Hoffman, and C.M. Marn, 1989. Use of mixed-function oxygenase to monitor contaminant exposure in wildlife. *Environmental Toxicology and Chemistry*, 8:1093-1102.

estimating missing values in a distribution even when data are limited as is the case for BAFs for PAH. This analysis indicates that although there is not enough information to define the distribution and correlations needed for a reliable Monte Carlo analysis that the estimation of 1000 is appropriate and within the range of uncertainty predicted for PAH compounds. For example 4 estimated BCFs for BAP in bluegill of 377, 608, 2657, and 3208 L/kg found in the literature were presented in two similar studies (Jimenez et al., 1987; McCarthy and Jimenez 1985). These values are within an order of magnitude and their geometric mean is near to 1000 L/kg (1182 L/kg). In addition, benz(a)anthracene is the only PAH considered in this listing with a measured BCF (350 L/kg). Based on these data EPA sees no reason to replace the previous value of 1000 L/kg from a reliable EPA source and used in the risk analysis for the proposed rule as a cap for BCF values without additional measurement data. After this uncertainty analysis the Agency believes this value is appropriate and sufficiently conservative. Details of the analysis are presented in the *Background document for the Uncertainty Analysis for the Petroleum Refining Waste Listing Decision.*

Comment 3: If EPA assumes PAH bioconcentration factors are a source of uncertainty, EPA cannot then ignore the pathways and risk entirely, thereby de facto assuming the pathways present no risks. Instead, EPA should consider the information qualitatively, and/or present a range of results based upon possible bioconcentration factors. (EDF, 00036)

Response: Again, these pathways have not been ignored. The available data indicates that PAHs are readily metabolized by fish and mammals and are not bioaccumulated at the very high rate estimated by a generic bioaccumulation factor based on K_{OW}, but at a rate several orders of magnitude less than the estimated values. However, no measurement data are available for calculating compound specific bioaccumulation factors for animals. A document has been prepared detailing an analysis of the uncertainty associated with the bioaccumulation of PAHs in fish and this document is included as Appendix C in the *Background Document for the Uncertainty Analysis for the Petroleum Refining Waste Listing Decision.* Similar or greater uncertainties may be associated with the bioaccumulation of PAHs in mammals as discussed in the uncertainty analysis.

Comment 4: The assumption that 100% of deposited constituents are bioavailable is overly conservative. This assumption is overly conservative because many constituents, particularly PAHs, bond tightly to soils and are unlikely to be available to an organism even if the soil is ingested. (EEI, 00026).

Response: See response to comment 6, Section III.F of this response to comment document.

$$RAF = \frac{fraction\ of\ BaP\ absorbed\ soil}{fraction\ of\ BaP\ absorbed\ diet}$$

Comment 5: The use of ingestion-based toxicity factors for the inhalation pathway is inappropriate, particularly for benzo(a)pyrene. In evaluating the risk posed by the PAHs contained in crude oil tank sludge and clarified slurry oil tank sludge the Agency appears to have calculated a risk from direct inhalation of PAH constituents (particularly benzo(a)pyrene ("BAP")) and used that value in the risk assessment. However, EEI is unaware of any valid toxicity factor for BAP by the inhalation route. Moreover, EPA's own guidance on PAH risk assessment states, "There is currently no inhalation unit risk for BAP that has been found acceptable by the CRAVE. At this time, there is no basis for judgment that BAP or other PAHs will be equipotent by oral and inhalation routes."[96] Yet, despite this statement in its own guidance document, EPA appears to have utilized the ingestion toxicity factor for BAP in calculating the inhalation risk. As the Agency's own guidance states, there is simply no support for the use of the ingestion factor in this route and the Agency should avoid an inhalation risk until it develops an appropriate risk factor. (EEI, 00026)

Response: The Agency agrees with the commenter. The inhalation CSF for BaP has been removed from IRIS and HEAST because it was determined that there were not sufficient existing data to support this benchmark, and thus it was not in concordance with the Agency proposed cancer guidelines.

Currently, no carcinogenicity assessment is available for BaP via inhalation exposure in IRIS[97] and HEAST[98]. The single study available for inhalation exposure of animals to BaP provided only questionable evidence of causality. In the study, hamsters exposed to BaP aerosols developed tumors in the nasal cavity, larynx, and trachea, pharynx, esophagus, and forestomach without involvement of the lungs[99]. In accordance with EPA's proposed cancer guidelines[100], BaP may belong to the category of cannot be determined for inhalation exposure based on Thyssen et al. As such, a CSF cannot be calculated for inhalation exposure for BaP. Additionally, the CSF for BaP for oral exposure may not be extrapolated for an inhalation CSF unless evidence (narration)

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[96] Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, Docket No. PRLP-S0433, p.9.

[97] U.S. Environmental Protection Agency (EPA). 1997. Integrated risk information system (IRIS). On-line database. Office of Research and Development (ORD). Cincinnati, OH.

[98] U.S. Environmental Protection Agency (EPA). 1995. Health Effects Assessment Summary Tables (HEAST). Office of Research and Development. May. EPA 540/R-95-036.

[99] J. Thyssen, J. Althoff, G. Kimmerle, U. Mohr. 1981. Inhalation studies with benzo[a]pyrene in Syrian golden hamster. *JNCI* 66:575-577.

[100] U.S. EPA. 1996. Proposed Guidelines for Carcinogen Risk Assessment. EPA/600/P-92/003C.

is provided to indicate that the mechanisms of cancer toxicity of BaP via the oral and inhalation routes is expected to be similar, in accordance to the proposed EPA cancer guidelines. Therefore, the inhalation CSF for BaP is not now considered valid and should be reevaluated.

Comment 6 : EPA's methodology may overestimate the amount of wind borne contaminants from landfills and land farming. In evaluating the risk posed by landfills and land farming, EPA assumes that contaminated soil is blown from the management unit and the contaminants are ingested either directly or indirectly. EPA's model may overestimate the amount of waste released from these units by utilizing soil rather than waste characteristics in calculating the amount of dispersion. Waste materials, including contaminated solid, are generally wetter and more compacted than soils, and thus are less likely to be dispersed by the wind. By utilizing values for parameters representing the moisture content and other properties of soils rather than of wastes in its model, EPA may have overestimated the release of hazardous constituents from these units and thus overestimated the risk they pose. (EEI, 00026)

Response: The Agency assumed that the soil in the land treatment unit was regularly tilled and, therefore, the soil and waste were well mixed.[101] The concentration of the constituents in the waste were assumed diluted due to the dispersion of the waste throughout the volume of soil within the area of the land treatment unit and the depth of incorporation. The properties of the soil-waste matrix, therefore, resemble the properties of the soil more than the properties of the waste and may be assumed to be dispersed more easily by the wind.

Comment 7 : EPA relied on outdated information to calculate soil ingestion risks; in fact, EPA ignored its own recent research on soil ingestion estimates. EPA used a maximum soil ingestion rate to represent central tendency when its own recent report suggested a lower average rate. Further, EPA apparently did not consider recent research showing that indoor soil is not equivalent to outdoor soil. The result is an overestimation of risks from incidental ingestion of soil. EPA used a soil ingestion rate of 100 mg/day for both central tendency and high-end risk estimates. This parameter should be represented by a distribution (or, at a minimum, a range) where 100 mg/day falls at the upper end.

A more reasonable scenario accounts for the probability that individuals ingest soil in proportion to the time spent at each location (i.e., away from home, indoors at home, outdoors at home). While the concentration of waste-related contaminants in soil ingested while away from the home should be zero, there is evidence to suggest that soil concentrations outside the home do influence concentrations inside the home. Calabrese and Stanek have estimated that 31.3 percent of indoor dust originates from outdoor soil[102]. Similarly, Chuang et al. have shown that indoor dust

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[101]This assumption was based on land treatment units observed during the Agency's field investigation.

[102]Calabrese and Stanek, 1992, "What Proportion of Household Dust Is Derived From Outdoor Soil? J. Soil Contam. 1(3):253-263.

concentrations are correlated to entryway soil (on inside doormat).[103] Although the percentage of indoor dust from outside sources is not specified, the concentration in indoor dust was always less than the concentration in entryway soil. (API, 00046)

Response: The soil ingestion rate has been addressed in the uncertainty and variability analysis conducted in support of the risk assessment for this rule. The distribution of values presented in the 1997 Exposure Factors Handbook was used and a discussion of the data distribution and the results are presented in the Supplemental Background Document for the NonGroundwater Risk Assessment; Uncertainty Analysis.

Comment 8 : The assumptions used in determining the risk to home gardeners are not realistic and overstate the risk to this subpopulation. First, EPA assumes that 38% of the U.S. population have gardens. According to the National Gardening Association's 1994-95 survey, there are three types of home gardens in the United States that are relevant for produce consumption in this rulemaking: vegetable, fruit, and berry. Their survey indicates that the percentage of the United States population having vegetable gardens is 31, fruit gardens is 14, and berry gardens is 6.[104]

These numbers should not be added to obtain a total percentage of gardens in the United States for two reasons. Adding the numbers assumes that all home gardeners grow only one type of produce which is clearly not the case. In addition, each of the garden types have different rates of produce consumption by the home gardener) and by using an average value or a worst case number would significantly overstate the amount of produce consumed by a home gardener. The assumption that 40% of the home gardener's total produce is home grown produce significantly overestimates the produce consumed and the resulting risk from the CSO residual. EPA does not use the most current data on garden type and rates of consumption for each produce type in its risk calculation. Instead of using 31% vegetable gardens with 17.3% intake and 14% fruit gardens with 10.1% intake, EPA chose to use 38% home gardens with 40% intake. (NPRA, 00015)

Response: The exposure factors used in the home gardener scenario reflect the values from the 1990 *Exposure Factors Handbook*. The distribution of the ingestion rates and exposure duration factors from the 1997 *Exposure Factors Handbook* are used in the uncertainty and variability analysis performed in support of the risk assessment for this rule. The location of potential home gardener receptors near site specific facilities have also been addressed in this analysis. A complete discussion of this analysis is presented in the Uncertainty Analysis: NonGroundwater Pathway Risk Assessment, 1998 .

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[103]Chuang et al., 1995, "Monitoring Methods For Polycyclic Aromatic Hydrocarbons And Their Distribution In House Dust And Track-In Soil." Environ. Sci. Technol. 29:494-500,

[104]National Gardening Survey 1994-95 pp 36, 55, and 64 respectively.

Comment 9 : EPA has incorrectly calculated risks to home gardeners from consumption of root vegetables. Based on API's efforts to recreate EPA's risk calculations using EPA's input parameters, it appears that EPA's estimate of risks from root vegetable consumption (see Table 9A of the commenter's submittal) are overestimated by two orders of magnitude.

EPA uses consumption rates of 0.028 kg/day for aboveground produce and 0.0003 kg/day for below ground produce. These values do not correspond to any consumption rates previously supported by EPA, and do not exist in the reference cited as the source (EPA, 1989, Exposure Factors Handbook). (API, 00046)

Response: EPA has examined the ingestion rate used for vegetables consumed by home gardeners and subsistence farmers and has corrected the error as indicated previously. This value has been used in all reanalyses for subsistence farmer and home gardener scenarios. In addition, biodegradation has been included in the reanalyses for receptor locations (home gardens, etc.) as well as the source locations (land treatment units). The exposure factors used for the risk assessment performed for the final rule for the home gardener scenario reflect the values from the 1990 *Exposure Factors Handbook*. The distribution of the ingestion rates and exposure duration factors from the 1997 *Exposure Factors Handbook* are included in the uncertainty and variability analysis performed in support of the risk assessment for this rule. The home gardener receptor locations have also been addressed in this analysis. A complete discussion of this analysis is presented in the Supplemental Background Document for the NonGroundwater Risk Assessment; Uncertainty Analysis.

Comment 10 : EPA's estimate of risks from CSO sediment due to the consumption of homegrown vegetables contains many mathematical errors, unsupported findings, and unjustified parameter values, which result in substantial overestimation of risks form this exposure route.

In Appendix F of RTI (1995) EPA presents its estimates for Bv, the ratio of chemical concentration in dry weight of produce to concentration in air (mg/g dry weight/mg/g air). Some of the values for Bv are calculated from Henry's constant and Kow using a relationship reported by Bacci et al[105]. Others are apparently calculated from the data provided by Simonich and Hites[106]. However, the equations and assumptions used to convert the vegetation-air partition coefficients (Kv) given by Simonich and Hites (1994) to the uptake coefficient (Bv) used by EPA are not given. Simonich and Hites (1994) give Kv values for various PAHs in terms of concentration of PAH in vegetable lipids divided by concentration of PAH in air. To convert from Kv to Bv (which uses concentration in vegetable dry weight), an assumption must be made

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[105]Bioconcentration Of Organic Chemical Vapors In Plant Leaves: Experimental Measurements And Correlation, Environ. Sci. Technol. 24(6):885-889. 1990.

[106]Simonich and Hites, 1994, "Vegetation-Atmosphere Partitioning Of Polycyclic Aromatic Hydrocarbons." Environ. Sci. Technol. 28:939-943.

as to the average lipid content of above ground produce. EPA does not provide either the calculation of Bv from Kv or the lipid content assumed for the calculations.(API, 00046)

Response: The issues concerning consumption rates were previously addressed in response to comment 9, above. The air-to-plant biotransfer factors used for most constituents in this analysis are measured values reported in Simonich and Hites (1994). The remaining BCF_vs are estimated from the K_{ow} using the Bacci equation. This may tend to over-estimate the bioaccumulation of constituents with very large K_{ow}s such as PAHs. In an effort to make this estimate agree more closely to real world values for very hydrophobic compounds without measured BCF_V values the BCF_v estimated using the Bacci equation was reduced by a factor of 40. This approach was presented in the Addendum to Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions (EPA/600/AP-93/003, page 5-9). No additional data are available for reducing the uncertainty associated with these factors.

Comment 11 : EPA over estimated the risk due to the consumption of root vegetables because Briggs et al.'s experiments used to derive the empirical equation used to estimate the concentration of organic compounds in root vegetables used barley plants. The concentrations measured for hydrophobic compounds in barley roots will be higher than concentrations expected for bulkier root vegetables such as carrots or potatoes. EPA (1993, Addendum, p. 5-3) suggested an empirical reduction factor to account for the lower surface area to volume ratio for edible root vegetables compared with barley. A factor of 0.01 was recommended based on the ratio for carrots. This factor should be incorporated into the calculation of Br for the PAHs, which are also highly lipophilic. Estimates of risk from consumption of root vegetables will, by including this factor, be reduced 100-fold. (API, 00046)

Response: This empirical correction factor was included in the equations used to calculate the contaminant concentration in root vegetables both in the risk assessment used to support the proposed rule and the NODA.

Comment 12 : EPA should perform a reasonableness check on the risk assessment results and to also think qualitatively about the risks to the home gardener. Does it seem reasonable that refineries with onsite land treatment units are allowing unrestricted soil erosion into home gardens? (Exxon, 00035)

Response: There are no data to document the location of residents near all petroleum refineries, however, in other industries residents have been documented to live nearby to the facilities and to raise produce for home consumption. This exposure scenario would be expected to occur near refineries as well. This analysis does not assume that all home gardens are in this location, only that home gardeners exist within the distribution of closest receptors. EPA believes these are reasonable assumptions, however, the distance from the LTU to the home gardener receptors has been included in the uncertainty and variability analysis conducted for the risk assessment for this rule and a complete discussion of the distance variability of home gardener receptors may be

found in the *Supplemental Background Document for the NonGroundwater Risk Assessment; Uncertainty Analysis*.

Comment 13 : Is it reasonable to assume that all home gardens are adjacent and downhill from land treatment units? (Exxon, 00035)

Response: The distance between the LTU and the home gardener receptor has been included as a variable in the uncertainty/variability analysis conducted in support of the risk assessment for this rule. A complete discussion of the location of home gardener receptors may be found in the Supplemental Background Document for the NonGroundwater Risk Assessment; Uncertainty Analysis.

Comment 14 : How important are erosion controls when the average and median distances from land treatment units to the nearest residence are on the order of 1 mile? (Exxon, 00035)

Response: Neither the distance from the LTU to current and potential residential receptors nor the presence and effectiveness of runoff controls can be verified. Therefore, the Agency will continue to use the assumptions presented in the proposed rule for a high end parameter of no run-off controls and for central tendency of 50 percent effective controls.

Comment 15 : Are storm water runoff controls in the Clean Water Act (40 CFR 122) sufficient to alleviate runoff concerns? (Exxon, 00035)

Response: Storm water runoff controls in the Clean Water Act (40 CFR 122) may or may not be sufficient to alleviate runoff concerns. The effectiveness cannot be validated.

N.   INFILTRATION RATES

Comment 1: EPA's EPACMTP -simulated groundwater exposure concentrations for the onsite landfill hydrorefining and hydrotreating catalyst scenarios are too high because an overly conservative infiltration rate was employed.

EPA uses a 50th percentile value of 5.3×10^{-7} cm/s (0.168 m/yr.) for the infiltration rate in the two parameter high-end analysis. In simple terms, the Agency is assuming the median Subtitle D landfill is built on a typical clay soil and the clay is always 100% water saturated (i.e., a unit gradient assumption). This is similar to saying that the median landfill has the same performance characteristics as an operating surface impoundment with a liner that has a saturated hydraulic conductivity 5.3×10^{-7} cm/s. However, in reality, the median value used by EPA resembles the worst case that could be expected at a landfill. Assuming saturated conditions is overly conservative and ignores the fact that most landfills by design have covers to divert precipitation.

EPA provides no justification for the assumptions it used to calculate the infiltration rate used in this rule. In the EPACMTP model, infiltration rate is the net rate of downward water flow

through the unsaturated zone to the water table. EPA developed infiltration rates for EPACMTP using its HELP model (Hydrologic Evaluation model for Landfill Performance). EPA's conceptual model for applying HELP to the refinery residual listing rule is (1) Subtitle D industrial landfills are located on soils that can be described as either sandy loam, silty loam and silty clay loam, to represent coarse, medium and fine textured soil and (2) coarse, medium and fine grained soil represent 15.4 percent, 56.6 percent and 28.0 percent, respectively, of the soils that have mapped around the country (based on the Soil Conservation Service database). EPA provides no technical basis for the assumption that the distribution of soil types used by HELP to generate infiltration rates for the EPACMTP model is representative of Subtitle D industrial landfills in operation today. The conceptual model also assumes that the vegetative cover resembles a 'fair' grass and the cover has a 2 percent top slope. However, none of the background documents provide any justification for these assumptions as they relate to the landfills used to manage refinery residuals.

EPA also should provide justification as to why RCRA §3007 survey data was not considered in determining the infiltration rate. The §3007 survey requested information about landfill cover design and composition, vegetation growing on the unit, landfill liners and their design and composition (including hydraulic conductivity) and unsaturated zone soil type. This information could be used to develop an infiltration rate appropriate for current refineries and the offsite landfills that they use, as opposed to the HELP-generated nationwide mean rate that the Agency chose to use.

To understand the effect of using more reasonable infiltration rates on groundwater exposure concentrations, API modeled EPA's two parameter, high-end analysis (no biodegradation) with infiltration/recharge rates of 10-8 and 10-9 cm/s. The results are presented in Table 21, "Comparison of impact of infiltration rates on refinery residual results" in Attachment 27 of the commenter's submittal (Review of EPA's Modeling Efforts Pertaining to the Listing of Refinery Residuals. Geotrans, Inc.). For both rates, nine year average groundwater exposure concentrations for benzene were less than its MCL. For arsenic, concentrations remained at zero after 10,000 years of simulation. (API, 00046; Shell, 00047)

Response: The Agency recognizes the commenter's concern for the representativeness of the modeling parameters. Two-parameter sensitivity analyses were performed for the critical waste streams in the current analysis. In the event that infiltration rate was determined to be a sensitive parameter, then infiltration rate was set at the 90th percentile. Otherwise, it was set at the 50th percentile. The infiltration rates used in EPACMTP were calculated from the HELP Model and do take into consideration the presence of a landfill cover and climate conditions[107]. Infiltration rates for a representative landfill design for each of the 97 climatic centers were calculated with the HELP model using the procedure and assumptions regarding design characteristics for each type of waste unit as described in the EPACMTP background document. Consequently, specific

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[107]Background Document for Metals. EPA's Composite Model for Leachate Migration with Transformation Products (EPACMTP). Volume I: Methodology. U.S. EPA.. 1996.

climate conditions at specific landfill locations have been taken into account in the analyses. Natural landfill covers rather than engineered covers were considered because, over the period time considered for modeling (10,000 years), engineered covers are very likely to weather and become more permeable.

O.   NON-INGESTION RISKS FROM GROUNDWATER CONTAMINATION

Comment 1: EPA considered the impacts of ingestion only. Without explanation or justification, the Agency ignored the risks of inhaling contaminants transferred to the air from showers, baths, toilets, dishwashers, washing machines, and cooking; and risks from dermal absorption of contaminants while washing, bathing, and showering. (EDF, 00036)

Response: EPA has considered non-ingestion risks from exposure to groundwater in response to this comment. EPA's approach is described in detail in the April 8, 1997 NODA background documents for indirect and direct risk assessment.

Comment 2: Since EPA never explains why inhalation or dermal risks were not considered, it is difficult to comment on possible rationales for this approach. Because dermal risks during bathing were included in the HWIR risk assessment proposed only one month later, there is certainly no technical bar precluding similar consideration in the instant rulemaking.

In the case of inhalation risks, EPA argued in the HWIR proposal that appropriate "chemical-specific" equations could not be found. Without addressing the merits of the Agency's position in the HWIR context, this rulemaking involves only a small fraction of the hazardous constituents addressed in HWIR, and for the most important of the volatile contaminants such as benzene, those equations are readily available in EPA's own CERCLA risk assessment guidance and in the published literature. (EDF, 00036)

Response: EPA has considered non-ingestion risks from exposure to groundwater in response to this comment, as described in the April 8, 1997 NODA's direct and indirect risk assessment background documents.

Comment 3: As a legal matter, the failure to consider important and documented groundwater risks violates the RCRA mandate to protect human health, and the mandate in Section 3-301(b) of Executive Order 12898 to identify multiple and cumulative exposures. (EDF, 00036)

Response: EPA has considered non-ingestion risks from exposure to groundwater in response to this comment, as described in the April 8, 1997 NODA's direct and indirect risk assessment background documents.

P. SURFACE IMPOUNDMENT LINER

Comment 1: EPA assumes the surface impoundments are equipped with a 2-foot soil liner with the relatively low permeability of 1×10^{-7} cm/sec in its groundwater model; there is no factual foundation for this assumption. (EDF, 00036; ETC, 00038)

Response: The surface impoundment scenario does not assume an engineered liner; rather, a natural sediment layer is assumed in the scenario. In a typical surface impoundment unit, after a brief period of operation, suspended solids in the waste water, often consisting of clay and silt particles, settle on the bottom of the unit. Owing to the natural filtering process occurring at the bottom surface of surface impoundment units, the filtered fine-grained materials would be trapped, thereby forming a low-permeability layer (otherwise known as clogging). After a long period of time, the low-permeability layer would increase in thickness due to accumulation of sediments, followed by consolidation due to the weights of the wastewater and the filtered materials. In many surface impoundment units, the thickness of the low-permeability layer is almost as great as the depth of the surface impoundment unit. The Agency believes that the assumed thickness of 2 feet for the consolidated barrier is reasonably conservative, given that the actual depth could be much greater than 2 feet. Furthermore, the assumed hydraulic conductivity of 1×10^{-7} cm/s is close to the middle of the silt-clay hydraulic conductivity range and the value is at the upper end of the range of clay hydraulic conductivity.

Q. DISTANCE TO NEAREST WELL/PLUME CENTERLINE

Comment 1: In the dye and pigment proposed listing determination, EPA used 48 meters as the high-end value for the distance to the nearest receptor well from an offsite landfill. Given the same offsite landfills may receive wastes from either or both industrial sectors, the choice of 102 meters in the instant rulemaking is arbitrary and unjustified, and is particularly inappropriate because of its profound effect on the listing determinations. (EDF, 00036)

Response: EPA notes in its Monte Carlo analysis, the Agency used the full distribution of available receptor well distances, including wells at smaller distances. The risk results for wastes of concern were presented in the NODA, and were subsequently revised as described elsewhere to yield the final results (Additional Groundwater Pathway Analysis, 1998). Concerning the well distance used in the dyes and pigments rule, EPA notes that the Agency used essentially the same underlying well distance data in this rule as was used in the current rule. The apparent high-end value used in this earlier rule (46 meters, not 48 meters cited by the commenter) represents the 95th percentile distance, and 104 meters is the 90th percentile. However, EPA states in the dyes and pigments rule risk documentation (see page 21, *Health Risk Assessment Background Document for the Dyes and Pigments Manufacturing Industry,* November, 1994, in the docket for that rule) that the high-end well distance of 46 meters was chosen because this was the *90th percentile* value. But as Table IV-2.7 in the risk document shows, the 90th percentile value actually was 104 meters, nearly the same as the 102 meters high-end value used in the current petroleum rulemaking. Therefore, the use of 46 meters in the dyes and pigments rule may have

been an oversight. Regardless, EPA believes that the 90th percentile value is more appropriate to use in the type of high end sensitivity analysis performed for this rulemaking, and that the 95th% value would be unreasonably conservative.

Comment 2: The 102 meter value is inconsistent with the comparable value used for the non-groundwater risk assessment. EPA assumed the distance to the nearest residence is 75 meters at the high-end and 305 meters at the 50 percent value in the non-groundwater risk assessment. This discrepancy between the distance values in the two risk assessments is never addressed or justified. (EDF, 00036)

Response: EPA disagrees that the distances must be equivalent, because different pathways are represented in each assessment. Exposure from groundwater pathways occurs through drinking water wells, and exposure from nongroundwater pathways occurs through multiple mechanisms, such as runoff and air releases. Therefore, EPA used different data sets to estimate receptor distances for these pathways to account for well locations for groundwater and residences for the nongroundwater pathways. For distances to residences in the nongroundwater pathways EPA used information compiled for Treatment Storage and Disposal Facilities (National Survey of Hazardous Waste Generators and Treatment, Storage, Disposal, and Recycling Facilities in 1986: Hazardous Waste Management in RCRA TSDR Units, July 1991).

The commenter correctly states that different receptor distance values are used for each of the ground water and non-ground water pathways; EPA believes that such use is appropriate. Specifically, the non-groundwater assessment used a high end (10th percentile) receptor distance of 75 meters and a central tendency (50th percentile) distance of 305 meters. See U.S. EPA, *Assessment of Risks from the Management of Petroleum Refining Wastes: Background Document*, August 1995. In contrast, the groundwater assessment used a high end (90th percentile) distance of 102 meters and a central tendency (50th percentile) distance of 430 meters. See U.S. EPA, *Petroleum Refining Waste Listing Determination: Background Document for Groundwater Pathway Analysis*, August 1995.

EPA justifies this difference based on the type of pathways used in each assessment. Exposure from groundwater pathways occurs, for almost all waste streams evaluated, through the consumption of groundwater downgradient of a landfill (other assessments included surface impoundments and land treatment units). To estimate receptor distances, EPA used data characterizing the distances of wells from landfills based on a previous OSW survey. See the March 1997 Supplemental Background Document for Groundwater Pathway Analysis. (Additional discussion concerning the distance to wells is found in Section I.A.6 of the NODA response to comments). Conversely, exposure from non-groundwater pathways occurs through multiple mechanisms (e.g., runoff, air releases) originating from a land treatment unit. Therefore, EPA used a different data set to estimate receptor distances for these pathways. EPA used data characterizing the distance from land treatment unit to surface water bodies, and also used these same values as the distances from the land treatment unit to gardens and other receptor locations. See U.S. EPA, *Assessment of Risks from the Management of Petroleum Refining Wastes:*

Background Document, August 1995. In summary, EPA believes it is reasonable that the receptor distance for nongroundwater exposure is closer the source than the receptor distance for groundwater exposure, because not all residents will have wells.

Comment 3: The commenter requests that EPA perform the two parameter high-end analysis using the 48 meter distance to the receptor well. (EDF, 00036)

Response: EPA conducted numerous revisions to its deterministic analysis. In addition to the deterministic modeling, EPA conducted a full, Monte Carlo based, probabilistic exposure assessment as a way of confirming the deterministic modeling analyses. See the March 1997 Supplemental Background Document for Groundwater Pathway Analysis. EPA did not change the deterministic analysis to include the 48 meter distance. However, in its Monte Carlo analysis, EPA used the full distribution of available receptor well concentrations, including wells at the 48 meter distance. These results are presented in the 1997 Groundwater NODA Background Document.

Comment 4: With respect to receptor well location in relation to the plume, EPA assumed in the two previous listing determination proposals that the receptor well is located in the plume centerline, in accordance with expressed Agency policy regarding listing determination risk assessments. However, in this rulemaking, EPA varies the location of the receptor well so that the highest concentrations in the groundwater may not reach the receptor well in a significant number of the modeling runs. No explanation or justification is provided regarding this violation of Agency policy, and the approach is inconsistent with RCRA's underlying goals of preventing pollution in the first instance, and protecting human health <u>and</u> the environment. Whether or a not a receptor well happens to be located in the plume centerline at a particular point in time is irrelevant to the presence of the plume itself and thus the protection of the resource for present and future uses. By juggling well locations, EPA is forsaking its mission of groundwater protection by playing geographic roulette with the health of the resource and its potential users. (EDF, 00036)

Response: EPA defined the well location for modeling purposes by using the distance perpendicular to the plume centerline (Y coordinate) and the distance from the landfill to the well (X coordinate. The X distance to the well discussed in the preceding comment. In the high-end analysis completed in the proposed rule, EPA fixed the Y coordinate of the receptor well location half-way between the plume centerline and the edge of the plume. However, the Agency has revised the two high-end parameter evaluation using a full sensitivity analysis for each waste, in which the Y-location of the well was either placed on the plume centerline (the high-end value) or at plume half-width (the median value). EPA has also performed Monte Carlo analyses in which the receptor well location was varied in such a way that the location reflected the nation-wide distribution given in the USEPA database of Subtitle D landfills. The final revised Monte Carlo analyses used the available distance to well data (X coordinate), and then randomly placed the well anywhere within the projected plume. Both of these approaches are more appropriate than what the commenter suggested, because placing the well on the plume centerline will tend to

overestimate risks in all affected wells by not considering other well locations. Therefore, EPA does not agree with the commenter, and believes that the approaches used by the Agency in the revised risk analysis fully considered well placement.

Comment 5: The distance of 75 meters to a receptor well in the groundwater pathway may be unreasonably conservative. Landfills that accept industrial wastes are generally larger landfills that have large buffer zones around them. (EEI, 00026)

Response: The commenter incorrectly states that 75 meters was used as the receptor distance for the ground water pathway (instead, 75 meters was the high end distance for non-ground water pathways). EPA calculated the 90th percentile distance of receptor well locations from landfills to be 102 meters, based on the results of an OSW survey of the distances of wells to municipal waste landfills. See U.S. EPA, *Health Risk Assessment: Background Document for the Dyes and Pigments Manufacturing Industry*, November 28, 1994. EPA acknowledges that it has no data characterizing receptor well distances from industrial landfills. In the absence of such information, EPA is using the data cited.

Comment 6: There is ample evidence in the RCRA §3007 Petroleum Refinery database that land treatment units average more than one mile from the nearest residence. (See submitted data) (Exxon, 00035)

Response: Because of the lack of completeness of the reported well distances in the Questionnaire, the Agency decided to use well distances from the Subtitle D Survey Database. The Questionnaire response was incomplete and inadequate Of the 172 RCRA §3007 questionnaires returned, 27 facilities reported the presence of nonhazardous on-site landfills used for the disposal of any waste in the survey in any year. Of these 27, EPA found that only 15 reported the distance to the nearest drinking water well with any reliable documentation (e.g., well location maps, groundwater flow gradients, company survey of nearby wells) (Additional Listing Support Analyses for the Petroleum Refining Listing Determination, 1998). This limited data set is not surprising given the problems associated with seeking information from the refineries that is not related to on-site operations. Furthermore, wells may be placed closer to the on-site landfills in the future. Therefore EPA relied on distances obtained from the OSW database as more representative of potential well locations. EPA notes that the Questionnaire only provides well location information for evaluating *on-site* landfills, and even if used, would not have impacted the modeling results for off-site landfills. Because the risks from off-site landfills were higher or comparable to risks calculated for on-site landfills, any change in the results for on-site landfills is unlikely to alter any decisions to list wastes.

R.   ADDITIVE RISKS ACROSS PATHWAYS

Comment 1: Despite clear Agency listing policy that the risks posed through different pathways should be summed when the potential for simultaneous exposure exists, the Agency did not follow that policy in this rulemaking. EPA did not sum these risks because it was assumed the

groundwater exposures were occurring after the non-groundwater exposures. However, the time of travel for benzene and perhaps other mobile constituents in EPA's groundwater risk assessment is 17 years or less, clearly within the period of time non-groundwater exposures may occur. Therefore, no credible reason remains for ignoring the cumulative risks from the various pathways. (EDF, 00036)

Response: As noted by the commenter, EPA's rationale for not adding risks from groundwater and non-groundwater pathways in its analysis for the proposed listing was based on the assumption that these exposures would not occur simultaneously. EPA reassessed this decision for the final rulemaking in light of the commenter's concerns. EPA agrees with the commenter that the noningestion exposure route for groundwater may be important for some constituents, and the Agency presented its analysis of such noningestion risks in the April 1997 NODA. For the wastes under study, this was only significant for benzene (no other toxic constituent of concern was volatile enough to affect the risk evaluation), and EPA's analysis resulted in effectively increasing risks from benzene projected to reach a receptor well by about 60% over the ingestion risk.(see Chapter 5, Supplemental Background Document for Groundwater, 1997). However, EPA does not agree with the commenter's suggestion that groundwater and nongroundwater risks should be combined. The only potential for the combination of groundwater and nongroundwater risks to be significant would be for a situation in which a landfill (with a groundwater release) was located in close proximity to a landtreatment unit (with release of contaminated soils). EPA examined the information provided in the §3007 Questionnaire for any sites where landfills and land treatment units are co-located, and presented the results in the April 1997 NODA. This analysis showed only one facility at which a nonhazardous land treatment unit and landfill were both located at the same site, and even in this one case the units are approximately 5,000 feet apart, making significant simultaneous exposure unlikely.

The closest residence exposed to the landfill groundwater risk and the closest residence exposed to the land treatment unit's non-groundwater risk are not the same residence. EPA determined that summing risks from the two exposure paths in this case is unwarranted because the potential for simultaneous exposure is virtually non-existent.

S.   THE PROBLEM WITH MCLs AS HEALTH-BASED EXIT LEVELS

Comment 1: The commenter does not support the use of MCLs which are set based on a zero criteria and recommends the use of PQLs as a practical alternative. (Shell, 00047)

Response: The groundwater risks calculated for arsenic were based on an HBN of 3.0×10^{-4} (0.0003) mg/l not on the MCL which is equal to 0.05 mg/l.

Comment 2: EPA used the MCL as the health-based number (HBN) considered protective of human health and the environment. In the case of arsenic, the MCL is not a true HBN; the MCL

for arsenic is orders of magnitude less protective than the comparable cancer risks from other HBNs. (EDF, 00036)

Response: MCLs were not used in the groundwater pathway risk assessment.