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Petroleum Refining Process Waste Listing Determination Proposed Rule Response to Comments Document; Part II

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
Biodegra dation 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-

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.

June 29, 1998   III-4

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

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

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 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

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

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 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 1* (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

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.

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

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

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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.

[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]

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

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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.

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 together 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 oil-bearing 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,

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]

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]

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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 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.

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).

- 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

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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.

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

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-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

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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.

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*

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.

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.

• 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.

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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.

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.

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 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]

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[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.

[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

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]

- 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

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[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.

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.

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 for individual waste streams 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 minimum 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 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

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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.

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.

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 all refinery wastes that could be landfilled over the unit's active life, 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

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

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.

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 not represent a high-end scenario for NAPL release.

For example, in evaluating the potential for NAPL release, a smaller landfill 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

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.

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 free 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)

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

Comment 2: In the carbamates listing determination, EPA assumed a 30 year active life for all 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 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

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 (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,

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[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.

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

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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.

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 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.

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

[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.

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 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)

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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.

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

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.

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*

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

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.