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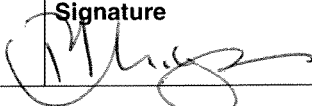
Effective Date: 1/21/2011      Next Review Date: December 17, 2016

## Environmental Programs Directorate

### Standard Operating Procedure

for **PERFORMING HUMAN AND ECOLOGICAL RISK  
 SCREENING ASSESSMENTS**

#### APPROVAL SIGNATURES:

<b>Subject Matter Expert:</b> Richard Mirenda	<b>Organization</b> ET-ER	<b>Signature</b> 	<b>Date</b> 1/12/2011
<b>Responsible Line Manager:</b> Patrick Nakagawa	<b>Organization</b> ET-ER	<b>Signature</b> 	<b>Date</b> 1/12/2011

## 1.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) states the responsibilities and describes the process for conducting and reporting risk assessments for the Los Alamos National Laboratory (LANL) and the Environmental Programs (EP) Directorate. This procedure integrates the criteria of the Quality Assurance Plan for the EP Directorate.

All **EP Directorate participants and subcontractors** shall implement this procedure when performing and reporting risk screening assessments for sites investigated by the Corrective Actions Project and the Technical Area 21 Closure Project.

## 2.0 BACKGROUND AND PRECAUTIONS

### 2.1 Background

The objective of the risk-based decision process is to ensure the protection of human health and the environment. Risk-based decision-making is a mechanism for identifying necessary and appropriate action throughout the corrective action process. Assessment of risk provides a basis for determining site status and is governed by acceptable risk levels established by the regulatory authorities. All potentially impacted sites require an assessment of potential human health risk(s)/radiation dose(s) and ecological risks to determine the need for corrective actions. Depending on the known or anticipated risks to human health and the environment, appropriate action may include site closure, completion of corrective actions, monitoring and data collection, remediation, and engineering and institutional controls. The risk-based decision process can be used to set priorities, determine cleanup standards, and prescribe management requirements for remediation.

### 2.2 Precautions

A risk assessment requires using this LANL-approved SOP and the latest risk assessment appendix annotated outline. Preassessment requirements include communicating with the EP Risk Assessment Coordinator to discuss the site(s) being assessed, current processes, and to determine any additional requirements specific for the assessment. The topics to discuss include applicable land use, exposure scenarios, exposure pathways, relevant lessons learned from recent risk screening assessments, applicable New Mexico Environment Department (NMED) concerns and comments, and approvals with modifications or directions related to the risk screening assessments. Risk assessors must organize and present the risk appendix consistent with this SOP and the latest annotated outline unless otherwise directed by the EP Risk Assessment Coordinator.

## 3.0 EQUIPMENT AND TOOLS

- Annotated Outline for Risk Assessment Appendix (SOP-5250, Selection and Use of Annotated Outlines/Templates for Consent Order Investigation Work Plans and Investigation Reports, Attachment 10).
- Risk appendix examples as provided by the EP Risk Assessment Coordinator.

## 4.0 STEP-BY-STEP PROCESS DESCRIPTION

### 4.1 Obtain background information and chemicals of potential concern (COPCs) for the sites subject to risk screening assessment.

Risk Assessor	1. Obtain background information for each site. The information should include relevant physical information on the site (e.g., location descriptions, geology, and topography), history associated with LANL operations, current site status, investigations conducted, and sampling results.
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- Risk Assessor (con't)
- Obtain a list of COPCs for each site based on the data review. Inorganic chemical and radionuclide COPC identification must follow SOP-5245, Background Value Comparisons – Inorganic Chemicals and SOP-5246, Background Value Comparisons – Radionuclides. Organic chemicals are identified as COPCs based on detection status.
- Note: COPCs are only identified for a site if the nature and extent of contamination is defined for that site.

#### 4.2 Determine conceptual site model for exposure for each site being evaluated.

- Risk Assessor
- Conduct site visit(s) and gather information regarding habitat, site conditions, potential receptors (human and ecological), media of concern, and structures/buildings.
  - In a figure, illustrate the contaminant source(s), release mechanisms, exposure pathways, and potential receptors. Determine all exposure pathways and environmental media relevant for the assessments. All potentially complete exposure pathways and receptors should be included. (Note: An example of a figure is provided in Attachment 1 and additional examples can be found in the annotated outline and previous risk appendices.)
  - Complete the Ecological Scoping Checklist (Attachment 2) for each site or group of sites to be evaluated for potential ecological risk. Include the checklist as an attachment to the risk appendix. (Note: The checklist can be completed for larger areas, if sites are closely associated spatially and/or functionally.)
  - Determine appropriate exposure scenario(s) for human health risk assessment. Possible current and reasonably foreseeable future land uses include industrial, construction worker, recreational, and residential. Residential exposure scenario is always evaluated per the Compliance Order on Consent (the Consent Order); other scenarios are evaluated as appropriate for the site(s).
  - Assess environmental fate and transport. Discuss inorganic chemicals, radionuclides, and organic chemicals separately and provide tables of soil/water partition coefficient ( $K_d$ ) values for the inorganic chemicals and radionuclides and a table of physical/chemical properties for organic chemicals. (Note: Use text and tables from annotated outline or from risk appendix examples provided by the EP Risk Assessment Coordinator and add or delete as appropriate.)

#### 4.3 Determine the COPCs and Exposure Point Concentrations (EPCs) for each exposure scenario and site.

- Risk Assessor
- Obtain the applicable data from the data steward or project subcontractor for each COPC, site, and scenario combination.
  - Identify COPCs for each site and scenario being evaluated from the list referred to in Section 4.1, Step 2 above, and based on the depth interval criteria described below in Step 3.

Risk Assessor (con't)

3. For soil exposure, the depth intervals to be included in the risk screening assessments need to be defined, based on the following exposure scenarios.
- For the industrial and recreational exposure scenarios, use depths of 0–1 ft below ground surface (bgs) (surface; nonintrusive exposure assumed).
  - For the construction worker exposure scenario, use depths from 0–10 ft bgs (default depth unless site-specific information available).
  - For the residential exposure scenario, use depths of 0–10 ft bgs.
  - For the ecological risk screening assessment, use depth of 0–5 ft bgs.

The top depth of the sample is used as the basis for including a sample in the risk screening assessment for a particular depth interval and scenario. All samples with a starting depth less than the lower bound of the interval for each scenario are included in the respective risk screening assessments. Some of the COPCs may not be evaluated for potential risk or dose under one or more scenarios because they are only reported below the depth interval associated with a given scenario.

Note: The above depth intervals are defaults and may be modified if warranted on a site-specific basis.

4. Calculate EPCs for each applicable COPC, site, and scenario combination. As noted above, all samples with a starting depth less than the lower bound of the interval for each scenario are included in the respective EPC determinations.
- Use U.S. Environmental Protection Agency (EPA) ProUCL program (most current version) to calculate the upper confidence limits (UCLs) of the arithmetic mean (<http://www.epa.gov/nerlesd1/tsc/software.htm>), if site data are adequate (see below for exceptions).
  - Select the ProUCL-recommended UCLs and methods for the EPCs.
  - For those EPCs calculated with ProUCL, provide inputs and outputs for each site and scenario separately in an Excel spreadsheet and include as an attachment to the risk appendix.
  - Use the maximum detected concentration as the EPC if there are too few detections (minimum of 5 detections but ideally 8–10 per ProUCL Users Guide) or if the UCL exceeds the maximum concentration of the data set.
  - Use the maximum detection limit if all data are nondetects for a COPC (typically used for some inorganic chemicals where the detection limit exceeds background).

Note: ProUCL Users Guide provides specific guidance on minimum samples required and use of nondetects.

- Summarize the EPCs in table(s) for each site and scenario (including ecological). Table(s) should include the COPC, number of analyses, number of detects, minimum concentrations, maximum concentrations, distribution types, EPCs, and EPC methods. (Note: Use table examples in annotated outline or from risk appendix examples provided by the EP Risk Assessment Coordinator.)

**4.4 Conduct human health risk screening assessment(s), including uncertainty analysis.**

Risk Assessor

1. Compile the soil screening levels/screening action levels (SSLs/SALs) for the chemical and radionuclide COPCs, respectively. This is done for each scenario being evaluated. Obtain the SSLs and SALs from the appropriate and most current versions of the NMED, EPA, and LANL guidance documents/spreadsheets/databases.
  - NMED (New Mexico Environment Department), December 2009. "Technical Background Document for Development of Soil Screening Levels, Revision 5.0, Volume 1, Tier 1: Soil Screening Guidance Technical Background Document," with revised Table A-1, New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2009, 108070)
  - NMED (New Mexico Environment Department), October 2006. "New Mexico Environment Department TPH Screening Guidelines," Santa Fe, New Mexico. (NMED 2006, 094614)
  - EPA Regional Screening Values are on-line. The Regional Table is the combination of Regions 3, 6, and 9 and represents a consistent approach in developing screening values. Reference the web address ([http://www.epa.gov/region06/6pd/rcra\\_c/pd-n/screen.htm](http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm)) in the text when using these values.
  - LANL (Los Alamos National Laboratory), May 2005. "Derivation and Use of Radionuclide Screening Action Levels, Revision 1," Los Alamos National Laboratory document LA-UR-05-1849, Los Alamos, New Mexico. (LANL 2005, 088493)
  - LANL (Los Alamos National Laboratory), December 2009. "Radionuclide Screening Action Level Updates," Los Alamos National Laboratory document LA-UR-09-8111, Los Alamos, New Mexico. (LANL 2010, 107655)
  - LANL (Los Alamos National Laboratory), February 2010. "Technical Approach for Calculating Recreational Soil Screening Levels for Chemicals, Revision 1," Los Alamos National Laboratory document LA-UR-09-7510, Los Alamos, New Mexico. (LANL 2010, 108613)

Note: NMED SSLs are the primary values used to conduct residential, industrial, and construction worker human health risk screening assessments for chemical COPCs. EPA regional screening levels are used only if NMED does not have a value for a COPC (EPA values for carcinogens are multiplied by 10 to achieve the 10<sup>-5</sup> target level used by NMED). LANL recreational SSLs are the only values available for this scenario. LANL SALs are the primary values used to conduct human health screening assessments for radionuclide COPCs.

EPA regional screening levels do not include construction worker values. If this scenario is relevant for a site, the construction worker SSL must be calculated using the toxicity value(s) from the EPA regional tables and the parameters and equations from NMED guidance (NMED 2009, 108070).

Some chemicals routinely analyzed for, and detected, do not have EPA-approved or provisional toxicity values. In this case, a similar chemical for which toxicity values are available is identified and used as a surrogate in the screening assessment. The similarity between chemicals may be based on chemical structure or because it is a parent compound or degradation product of the chemical. Consult with the Risk Assessment Coordinator as to whether a surrogate is available or if the chemical should be evaluated qualitatively in the uncertainty analysis.

Risk Assessor (con't)

2. Summarize key exposure parameters for the SSLs and SALs for each scenario in a table(s). (Note: Use table examples in annotated outline or from risk appendix examples provided by the EP Risk Assessment Coordinator. There is no need to change from previous versions unless SSLs/SALs have been revised and parameters changed.)
3. Compare appropriate EPCs with the scenario-specific SSLs and SALs and calculate risk/dose to be compared with NMED and U.S. Department of Energy (DOE) requirements. Noncarcinogens, carcinogens, and radionuclides are compared separately for each site/scenario. (Note: Total petroleum hydrocarbon (TPH) is evaluated separately from the other noncarcinogen COPCs and presented independently of the noncarcinogen screening results.)
4. Calculate hazard quotient (HQ), cancer risk, and/or dose for each COPC/scenario/site. (The values are calculated as the ratios of the EPC for a COPC to the SSL/SAL times the target level of 1 [noncancer hazard],  $1 \times 10^{-5}$  [cancer risk], or 15 mrem/yr [radiation dose]. TPH is compared to the appropriate screening guideline separately from the SSL comparisons.)
5. Sum the following: (1) HQs to obtain the hazard index (HI) for noncarcinogenic COPCs (HQs/HI for TPH calculated separately), (2) the cancer risks to obtain the total excess cancer risk for carcinogenic COPCs, and (3) the doses to obtain the total dose for radionuclide COPCs for each scenario/site. (Summarize comparisons in tables for each site and scenario [include COPCs, EPCs, SSLs/SALs, HQs/HI, cancer risks/total excess cancer risk, doses/total dose in tables].) (Note: Use tables from the annotated outline or from risk appendix examples provided by the EP Risk Assessment Coordinator.)
6. The contribution of the vapor intrusion pathway to the site cancer risk and HI for the residential and industrial scenarios must be indicated as appropriate. This pathway must be assessed using available draft EPA guidance (<http://www.epa.gov/correctiveactions/eis/vapor.htm>). The approach includes using the Johnson and Ettinger vapor intrusion model (available for download at [http://www.epa.gov/swerrims/riskassessment/airmodel/johnson\\_ettinger.htm](http://www.epa.gov/swerrims/riskassessment/airmodel/johnson_ettinger.htm)). If the vapor intrusion pathway is not complete or is potentially not a complete exposure pathway, the risk assessor must discuss the reasons why this pathway is not evaluated.
7. Present overall results of comparisons in text for each scenario. For each site, include the HI, total excess cancer risk, and total dose calculated. Indicate whether the totals are above, equivalent to, or less than the NMED target HI of 1, the NMED target risk level of  $1 \times 10^{-5}$ , or the DOE target radiation dose limit of 15 mrem/yr.
8. Conduct uncertainty analyses for the risk screening assessments. Include data evaluation, COPC identification, exposure assessment, toxicity assessment, and additive approach. Indicate whether potential biases under- or overestimates the risk/dose and/or exposure. Recalculate hazard/risk/dose based on uncertainty analysis as appropriate to determine if HQs/HIs, cancer risk, and/or dose changes. (Note: Use boilerplate text from the annotated outline or from examples in the risk appendix that are provided by the EP Risk Assessment Coordinator and include site-specific uncertainties where appropriate.)

Risk Assessor (con't)

9. Uncertainty discussions should include (1) the applicability of scenarios, particularly the scenario used to determine site status, (2) EPCs as related to the representativeness of exposure (e.g., indicate if EPC is similar to background, if it is the maximum detected concentration, or if COPC is infrequently detected), and (3) discuss the use of surrogate chemicals and the potential effect on hazard/risk/dose estimates.
10. Summarize and interpret risk screening results for each site, including the results of the uncertainty analysis. Include equivalent total risk for radionuclides, based on a comparison with EPA's preliminary remediation goals for radionuclides ([http://epa-prgs.ornl.gov/radionuclides/download/rad\\_master\\_prg\\_table\\_pci.xls](http://epa-prgs.ornl.gov/radionuclides/download/rad_master_prg_table_pci.xls)) for the residential and industrial scenarios (also use industrial values for construction worker). (EPA values are multiplied by 10 to achieve the  $10^{-5}$  target level used by NMED). The total risk for the recreational scenario is provided, based on a conversion from soil concentration to radiation dose using the residual radioactive material computer model (RESRAD).

#### 4.5 Conduct ecological risk screening assessment(s), including uncertainty analysis.

Risk Assessor

1. Obtain applicable ecological screening levels (ESLs) from the most recent version of the ECORISK Database for each COPC for the 0–5-ft depth interval. LANL ESLs are the primary values used to conduct ecological risk screening assessments for all COPCs. The ESLs are summarized in a table in the section discussing the ecological risk screening assessment. (Note: See the annotated outline or risk appendix examples provided by the EP Risk Assessment Coordinator.)
2. Compare the ecological EPCs with the minimum ESL for each COPC and calculate the HQ. If the HQ is above 0.3, identify COPC as a chemical of potential ecological concern (COPEC). If HQ is 0.3 or less, eliminate it as a COPEC (not evaluated further). Summarize the comparison to the minimum ESLs in a table (include COPCs, EPCs, minimum ESLs, receptors, and HQs). (Note: Use tables from annotated outline or from risk appendix examples provided by the EP Risk Assessment Coordinator.)
3. Identify COPCs without ESLs and retain as COPECs.
4. Conduct an HI analysis for all COPECs identified that have at least one ESL. Calculate HQ for each COPEC/receptor combination. Sum the HQs for each receptor to obtain the receptor HI for the site. Present HI analysis in a table (include COPECs, EPCs, receptors, HQs, and HIs). If there is no ESL available for a given receptor, indicate as not available (na). (Note: Use tables from annotated outline or from risk appendix examples provided by the EP Risk Assessment Coordinator.)
5. Determine whether receptor HIs are above, equivalent to, or less than 1. If the receptor HI is equivalent to or less than 1, no further evaluation is required for that receptor. If the receptor HI is above 1, further evaluation in the uncertainty analysis is required.

Risk Assessor (con't)

6. Conduct uncertainty analyses for the ecological risk screening assessment(s), including discussions, comparisons, and calculations related to chemical form, exposure assumptions, toxicity values, comparison of EPCs to background, area use factors (AUFs), population area use factors (PAUFs), lowest observed adverse effect level (LOAEL) analysis, COPECs without ESLs (if applicable), comparison to previous field investigations (if applicable), and a Tier 1 biota dose evaluation in accordance with DOE's A Graded Approach for Evaluating Radiation Doses to Aquatic And Terrestrial Biota (<http://www.hss.doe.gov/nuclearsafety/ns/techstds/standard/std1153/1153.htm>) (if applicable).

Note: Use boilerplate text from the annotated outline or from the risk appendix examples provided by the EP Risk Assessment Coordinator. Include site-specific uncertainties where appropriate.

7. Compare the EPCs for the inorganic COPECs with background concentrations to determine whether exposure to these inorganic chemicals across the site is similar to background.

Similarity to background is determined if the EPC is less than or equivalent to the maximum concentrations in the background data sets, as presented in LANL 1998, 059730. Equivalency is generally interpreted as when the EPC is less than a factor of 2 of the maximum background concentration.

The comparison to background should be conducted for each site where inorganic COPECs are still present, and if determined to be similar to background, eliminate as a COPEC; if not, retain and evaluate further. Summarize in a table for each site (include inorganic COPECs, EPCs, soil background concentration range, tuff background concentration, and sediment background concentration as appropriate). (Note: If the inorganic COPEC has only a background value, present this in the table and footnote.)



Risk Assessor (con't)

8. Evaluate HQs/HIs using AUFs and PAUFs.

- Individual AUFs are evaluated for threatened and endangered (T&E) species (e.g., Mexican spotted owl). (Note: The kestrel top carnivore HI is used as the surrogate receptor for the Mexican spotted owl in the risk screening assessment.)
- For other wildlife receptors, use the PAUFs. AUFs and PAUFs are not applied to the plant and earthworm.
- AUFs and PAUFs are calculated by dividing the site area(s) by the individual home range and population home ranges, respectively, for the receptors. See previous reports for examples. [Note: Individual and population home ranges are obtained from EPA's Wildlife Exposure Factors Handbook (EPA 1993, 059370).]
- Present AUF(s) and PAUFs in a table(s) for each site (include receptors, home ranges, population home ranges, and AUF(s)/PAUFs), and footnote table(s) explaining how factors are calculated. (Note: See annotated outline or risk appendix examples provided by the EP Risk Assessment Coordinator.)
- Modify the list of COPECs based on the elimination of inorganic COPECs that are similar to background concentrations according to Step 7. Multiply the remaining HQs or the new HIs by the AUF/PAUFs (multiplying only the HIs is simpler).

Present the adjusted HQs/HIs in a table(s). The format of the table(s) is similar to the HI analysis table(s), except for the inclusion of the adjusted HIs. (Note: See annotated outline or risk appendix examples provided by the EP Risk Assessment Coordinator.)

9. Conduct LOAEL analysis if adjusted HIs are greater than 1.

- A LOAEL analysis is conducted using ESLs calculated based on a LOAEL rather than a no observed adverse effect level. The LOAEL analysis is conducted only on those COPECs that contribute an adjusted HQ greater than 0.3 to an HI greater than 1.
- The LOAEL-based ESLs are calculated based on toxicity information in the most recent version of the ECORISK Database and are presented in a table along with the basis for each LOAEL used in the ESL calculations. (Note: See the annotated outline or risk appendix examples provided by the EP Risk Assessment Coordinator.)
- The HQs and HIs calculated for this subset of receptors and COPECs are also adjusted using the PAUFs, if the wildlife receptor HIs exceeded 1, using the LOAEL-based ESLs. (Note: See the annotated outline or risk appendix examples provided by the EP Risk Assessment Coordinator.)

LOAEL-based ESLs for each COPEC will be included in the 2011 release of the ECORISK Database. Until then the risk assessor must contact the EP Risk Assessment Coordinator if COPECs require LOAEL-based ESLs to be calculated. The EP Risk Assessment Coordinator will forward the request to the database person and provide the risk assessor with the required LOAEL-based ESLs and supporting information for inclusion into the risk assessment appendix. This request must be done as soon as possible in order to complete the risk screening assessment in a timely manner.

Risk Assessor (con't)

10. If the radionuclide COPCs includes cesium-137 and/or strontium-90, compare the EPCs with DOE's Biota Concentration Guides (BCGs) (<http://www.hss.doe.gov/nuclearsafety/ns/techstds/standard/std1153/1153.htm>) (if applicable) in the text (DOE BCGs for these two radionuclides are lower than the minimum ESLs). Indicate BCGs and minimum ESLs and calculate HQ(s) using the BCG(s). Indicate whether HQs impact the HIs for the site.

See annotated outline or previous reports for presentation and boilerplate text. State that the DOE BCG incorporates bioaccumulation factors that are orders of magnitude higher than those in the ECORISK Database, and environmental surveillance and monitoring indicate that bioaccumulation factors are not as high as those used by DOE.

11. Discuss COPECs without ESLs for each site. Discussion should include some or all of the following.
- Provide the number of detected concentrations and the maximum detected concentration or UCL.
  - If COPEC is naturally occurring but has no background data (e.g., nitrate), indicate whether concentrations reflect natural background levels.
  - If COPEC has background data, compare EPC with background concentrations to determine if exposure is similar to background (see Step 7 above).
  - If there is an interim ESL available use this value to evaluate the COPEC. Compare the minimum interim ESL with the EPC and present the HQ. If the HQ exceeds 1, apply the AUF/PAUF, as appropriate.
  - If there is an appropriate surrogate chemical/radionuclide, which has an ESL, compare the minimum ESL for the surrogate with the EPC and present the HQ. If the HQ exceeds 1, apply the AUF/PAUF, as appropriate.
  - Present the residential SSL and state if the SSL indicates high, moderate, low, or very low toxicity.
  - Conclude, based on all of the lines of evidence, whether the COPEC is eliminated.

Note: Use annotated outline or risk appendix examples provided by the EP Risk Assessment Coordinator for boilerplate text to explain how and why this is done.

12. Indicate whether biota investigations have been conducted in other canyon reaches and provide references for these investigation reports. Indicate the types of field and laboratory studies conducted and whether similar concentrations of COPECs indicated effects and whether the results support the results of the risk screening assessments. Include a table or text comparing the concentrations detected in the canyons to the EPCs evaluated for potential risk.

Note: This step is only included if the risk screening results warrants additional lines of evidence. See annotated outline or from risk appendix examples provided by the EP Risk Assessment Coordinator.

Risk Assessor (con't)

13. Summarize and interpret ecological risk screening results for each site including the results of the uncertainty analysis. See annotated outline or previous reports for examples.
  - Present lines of evidence used for each receptor to determine whether there is the potential for adverse impacts.
  - Receptor lines of evidence may include minimum ESL comparisons, HI analyses, comparison to background concentrations, potential effects to populations (individuals for T&E species), comparisons to previous field and laboratory studies, and LOAEL analyses.
  - Organize lines of evidence in sequence presented in the uncertainty analysis, beginning with minimum ESL comparisons and including all **relevant** lines of evidence.
14. Conclude whether there are or are not potentially unacceptable risks or doses from COPECs. Indicate whether the lines of evidence support the conclusion that there is or is not a potential ecological risk to receptors at the sites.

#### 4.6 Prepare draft risk appendix according to requirements outlined in the Consent Order.

Risk Assessor

1. Obtain risk appendix annotated outline from SOP-5250 (Attachment 10) and/or risk appendix examples from the EP Risk Assessment Coordinator. Risk appendix should be presented per the annotated outline and/or examples, which generally follow previously accepted appendices and Consent Order requirements. The document should include applicable boilerplate text, which is modified as appropriate for the specific sites being assessed.
2. Basic elements of the risk appendix (see annotated outline) include the following:
  - Introduction—general overview of risk screening assessment process and sites evaluated.
  - Background—site descriptions, investigation sampling results, and determination of COPCs.
  - Conceptual site model—receptors and exposure pathways, environmental fate and transport, and EPC calculations.
  - Human health risk screening assessments—SSLs/SALs, results of evaluations, uncertainty analysis, and interpretation.
  - Ecological risk screening assessments—scoping evaluation, assessment endpoints, ESLs, results from screening evaluation, uncertainty analysis, lines of evidence, and interpretation.
  - Conclusions—state whether there is potentially unacceptable risk or dose to human and ecological receptors, based on the results of the risk screening assessments for each site.
3. Submit draft risk screening assessment appendix to the project leader and EP Risk Assessment Coordinator for review and comments.

## 5.0 DEFINITIONS AND ACRONYMS

AUF	area use factor
BCG	Biota Concentration Guide
bgs	below ground surface
Consent Order	Compliance Order on Consent
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
DOE	Department of Energy (U.S.)
EP	Environmental Programs
EPA	Environmental Protection Agency (U.S.)
EPC	exposure point concentration
ESL	ecological screening level
HI	hazard index
HQ	hazard quotient
LANL	Los Alamos National Laboratory
LOAEL	lowest observed adverse effect level
NMED	New Mexico Environment Department
PAUF	population area use factor
RESRAD	residual radioactive material (computer code)
SAL	screening action level
SOP	standard operating procedure
SSL	soil screening level
T&E	threatened and endangered
TPH	total petroleum hydrocarbon
UCL	upper confidence limit

## 6.0 PROCESS FLOW CHART

Flow Diagram for the Risk Screening Assessment Process

## 7.0 ATTACHMENTS

Attachment 1 Example of Conceptual Human Exposure Model for Risk Screening Assessments

Attachment 2 Ecological Scoping Checklist

**8.0 REVISION HISTORY**

Revision No. <i>(Enter current revision number, beginning with Rev.0)</i>	Effective Date <i>(Document Control Coordinator inserts effective date for revision)</i>	Description of Changes <i>(List specific changes made since the previous revision)</i>	Type of Change <i>(Technical [T] or Editorial [E])</i>
0	5/15/09	New document	E
SOP-5244, R0	1/21/2011	Updated risk assessment screening process based on NMED comments, organizational changes, and new approaches. Assigned new document control tracking number, EP-DIV-SOP-10006, R0.	T

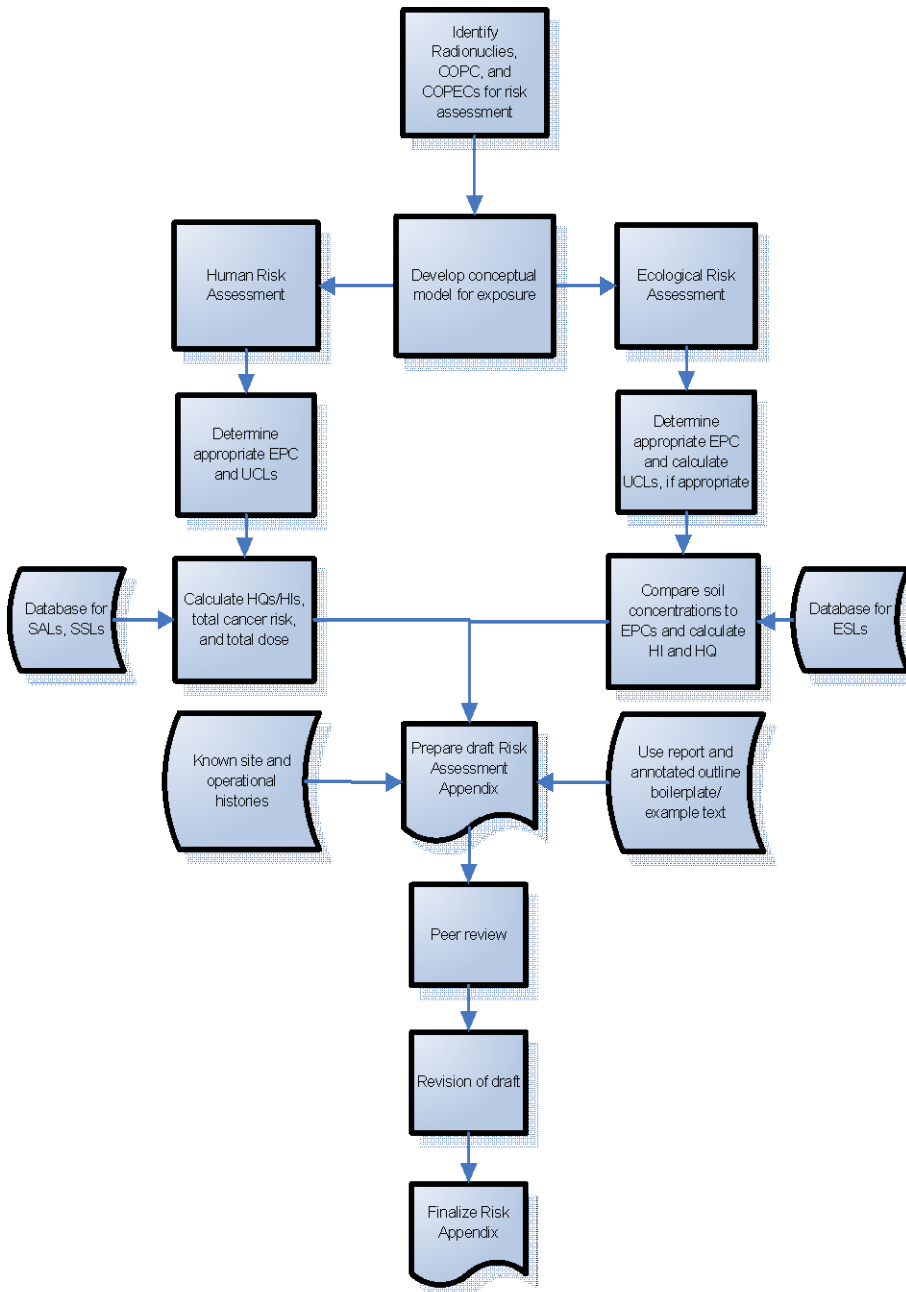
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FLOW DIAGRAM

FLOW PROCESS FOR HUMAN AND ECOLOGICAL RISK ASSESSMENT

Records Use only

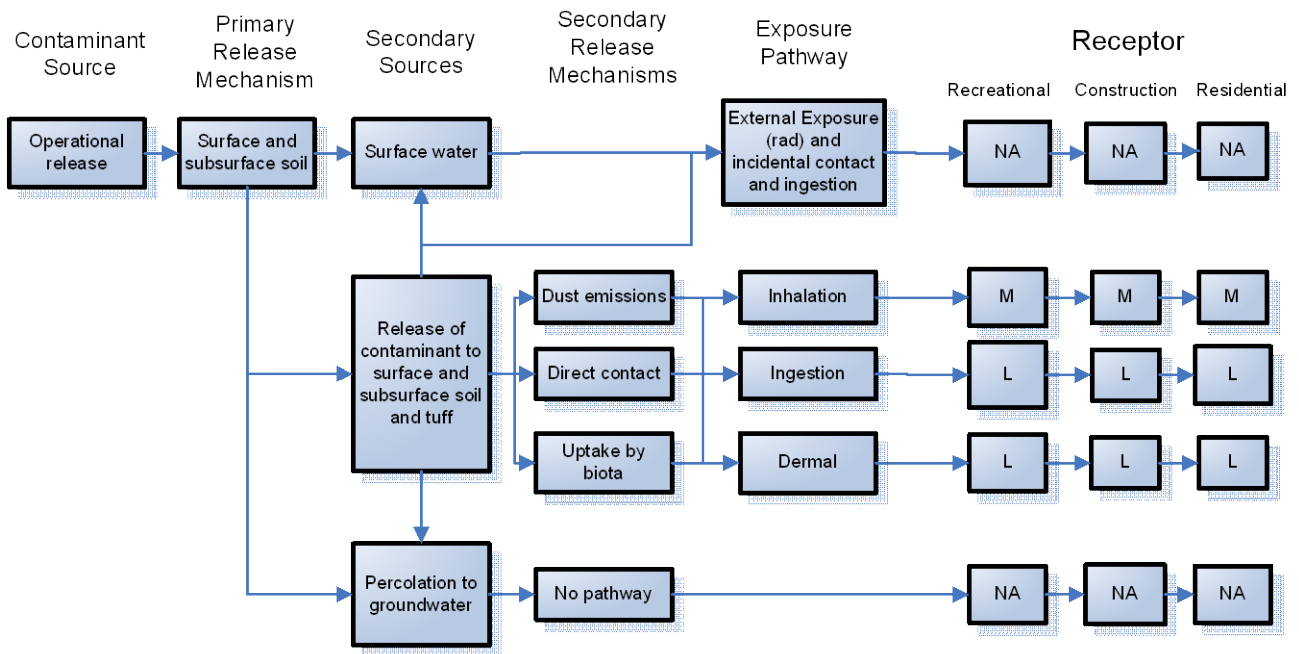


ATTACHMENT 1


EP-DIV-SOP-10006-1

EXAMPLE OF CONCEPTUAL EXPOSURE MODEL FOR HUMAN RISK ASSESSMENT

Records Use only



Exposure: Exposure:  
 VL-Very Low      L-Low  
 M- Medium      NA- Not Applicable

ATTACHMENT 2	
<b>EP-DIV-SOP-10006-2</b>  <b>ECOLOGICAL SCOPING CHECKLIST AND CONCEPTUAL MODEL</b>	Records Use only  

**A-1.0 PART A—SCOPING MEETING DOCUMENTATION**

<b>Site ID</b>	
<b>Form of site releases (solid, liquid, vapor). Describe all relevant known or suspected mechanisms of release (spills, dumping, material disposal, outfall, explosive testing, etc.) and describe potential areas of release. Reference locations on a map as appropriate.</b>	
<b>List of Primary Impacted Media (Indicate all that apply.)</b>	Surface soil – Surface water/sediment – Subsurface – Groundwater – Other, explain –
<b>Vegetation class based on GIS vegetation coverage (Indicate all that apply.)</b>	Water – Bare Ground/Unvegetated – Spruce/fir/aspens/mixed conifer – Ponderosa pine – Piñon juniper/juniper savannah – Grassland/shrubland – Developed – Burned –
<b>Is T&amp;E Habitat Present? If applicable, list species known or suspected of using the site for breeding or foraging.</b>	
<b>Provide list, of Neighboring/ Contiguous/ Upgradient sites, includes a brief summary of COPCs and the form of releases for relevant sites and reference a map as appropriate. (Use this information to evaluate the need to aggregate sites for screening.)</b>	
<b>Surface Water Erosion Potential Information Summarize information including the terminal point of surface water transport, slope, and surface water run-on sources.</b>	



**A-2.0 PART B—SITE VISIT DOCUMENTATION**

<b>Site ID</b>	
<b>Date of Site Visit</b>	
<b>Site Visit Conducted by</b>	

**Receptor Information:**

<b>Estimate cover</b>	Relative vegetative cover (high, medium, low, none) = Relative wetland cover (high, medium, low, none) = Relative structures/asphalt, etc., cover (high, medium, low, none) =
<b>Field notes on the GIS vegetation class to assist in verifying the Arcview information</b>	
<b>Are ecological receptors present at the site? (yes/no/uncertain)</b> <b>Describe the general types of receptors present at the site (terrestrial and aquatic), and make notes on the quality of habitat present at the site.</b>	

**Contaminant Transport Information:**

<b>Surface water transport</b> <b>Field notes on the erosion potential, including a discussion of the terminal point of surface water transport (if applicable).</b>	
<b>Are there any off-site transport pathways (surface water, air, or groundwater)? (yes/no/uncertain)</b> <b>Provide explanation</b>	

**Ecological Effects Information:**

<b>Physical Disturbance</b> <b>(Provide list of major types of disturbances, including erosion and construction activities, review historical aerial photos where appropriate.)</b>	
<b>Are there obvious ecological effects? (yes/no/uncertain)</b> <b>Provide explanation and apparent cause (e.g., contamination, physical disturbance, other).</b>	

**No Exposure/Transport Pathways:**

**If there are no complete exposure pathways to ecological receptors onsite and no transport pathways to off-site receptors, the remainder of the checklist should not be completed. Stop here and provide additional explanation/justification for proposing an ecological No Further Action recommendation (if needed). At a minimum, the potential for future transport should include the likelihood that future construction activities could make contamination more available for exposure or transport.**

**Adequacy of the Characterization**

<p><b>Do existing or proposed data provide information on the nature and extent of contamination?</b> <b>(yes/no/uncertain)</b> <b>Provide explanation</b> <b>(Consider if the maximum value was captured by existing sample data.)</b></p>	
<p><b>Do existing or proposed data for the site address potential transport pathways of site contamination?</b> <b>(yes/no/uncertain)</b> <b>Provide explanation</b> <b>(Consider if other sites should be aggregated to characterize potential ecological risk.)</b></p>	
<p><b>Provide additional field notes on the site setting and potential ecological receptors.</b></p>	

### A-3.0 PART C—ECOLOGICAL PATHWAYS CONCEPTUAL EXPOSURE MODEL

Provide answers to Questions A to V to develop the Ecological Pathways Conceptual Exposure Model

#### **Question A:**

Could soil contaminants reach receptors through vapors?

Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant  $>10^{-5}$  atm-m<sup>3</sup>/mol and molecular weight  $<200$  g/mol).

**Answer (likely/unlikely/uncertain):**

**Provide explanation:**

#### **Question B:**

Could the soil contaminants reach receptors through fugitive dust carried in air?

Soil contamination would have to be on the actual surface of the soil to become available for dust.

In the case of dust exposures to burrowing animals, the contamination would have to occur in the depth interval where these burrows occur.

**Answer (likely/unlikely/uncertain):**

**Provide explanation:**

#### **Question C:**

Can contaminated soil be transported to aquatic ecological communities?

If erosion is a transport pathway, evaluate the terminal point to see if aquatic receptors could be affected by contamination from this site.

**Answer (likely/unlikely/uncertain):**

**Provide explanation:**

#### **Question D:**

Is contaminated groundwater potentially available to biological receptors through seeps or springs or shallow groundwater?

Known or suspected presence of contaminants in groundwater.

The potential for contaminants to migrate through groundwater and discharge into habitats and/or surface waters.

Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone.

Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.

**Answer (likely/unlikely/uncertain):**

**Provide explanation:**

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**Question E:**

Is infiltration/percolation from contaminated subsurface material a viable transport and exposure pathway?

The potential for contaminants to migrate to groundwater.

The potential for contaminants to migrate through groundwater and discharge into habitats and/or surface waters.

Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone.

Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.

**Answer (likely/unlikely/uncertain):**

**Provide explanation:**

**Question F:**

Might erosion or mass wasting events be a potential release mechanism for contaminants from subsurface materials or perched aquifers to the surface?

This question is only applicable to release sites located on or near the mesa edge.

Consider the erodability of surficial material and the geologic processes of canyon/mesa edges.

**Answer (likely/unlikely/uncertain):**

**Provide explanation:**

**Question G:**

Could airborne contaminants interact with receptors through the respiration of vapors?

Contaminants must be present as volatiles in the air.

Consider the importance of the inhalation of vapors for burrowing animals.

Foliar uptake of vapors is typically not a significant exposure pathway.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Plants:**

**Terrestrial Animals:**

**Provide explanation:**

**Question H:**

Could airborne contaminants interact with plants through the deposition of particulates or with animals through the inhalation of fugitive dust?

Contaminants must be present as particulates in the air or as dust for this exposure pathway to be complete.

Exposure through the inhalation of fugitive dust is particularly applicable to ground-dwelling species that would be exposed to dust disturbed by their foraging or burrowing activities or by wind movement.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Plants:**

**Terrestrial Animals:**

**Provide explanation:**

**Question I:**

Could contaminants interact with plants through root uptake or rain splash from surficial soil?

Contaminants in bulk soil may partition into soil solution, making them available to roots.

Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash).

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Plants:**

**Provide explanation:**

**Question J:**

Could contaminants interact with receptors through food-web transport from surficial soil?

The chemicals may bioaccumulate in animals.

Animals may ingest contaminated food items.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Animals:**

**Provide explanation:**

**Question K:**

Could contaminants interact with receptors through the incidental ingestion of surficial soil?

Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil, or while grooming themselves clean of soil.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Animals:**

**Provide explanation:**

**Question L:**

Could contaminants interact with receptors through dermal contact with surficial soil?

Significant exposure through dermal contact would generally be limited to organic contaminants that are lipophilic and can cross epidermal barriers.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Animals:**

**Provide explanation:**

**Question M:**

Could contaminants interact with plants or animals through external irradiation?

External irradiation effects are most relevant for gamma-emitting radionuclides.

Burial of contamination attenuates radiological exposure.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Plants:**

**Terrestrial Animals:**

**Provide explanation:**

**Question N:**

Could contaminants interact with plants through direct uptake from water and sediment or sediment rain splash?

Contaminants may be taken up by terrestrial plants whose roots are in contact with surface waters.

Terrestrial plants may be exposed to particulates deposited on leaf and stem surfaces by rain striking contaminated sediments (i.e., rain splash) in an area that is only periodically inundated with water.

Contaminants in sediment may partition into soil solution, making them available to roots.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Plants:**

**Provide explanation:**

**Question O:**

Could contaminants interact with receptors through food-web transport from water and sediment?

The chemicals may bioconcentrate in food items.

Animals may ingest contaminated food items.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Animals:**

**Provide explanation:**

**Question P:**

Could contaminants interact with receptors through the ingestion of water and suspended sediment?

If sediments are present in an area that is only periodically inundated with water, terrestrial receptors may incidentally ingest sediments.

Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Animals:**

**Provide explanation:**

**Question Q:**

Could contaminants interact with receptors through dermal contact with water and sediment?

If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods.

Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Animals:**

**Provide explanation:**

**Question R:**

Could suspended or sediment-based contaminants interact with plants or animals through external irradiation?

External irradiation effects are most relevant for gamma-emitting radionuclides.

Burial of contamination attenuates radiological exposure.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Terrestrial Plants:**

**Terrestrial Animals:**

**Provide explanation:**

**Question S:**

Could contaminants bioconcentrate in free-floating aquatic, attached aquatic plants, or emergent vegetation?

Aquatic plants are in direct contact with water.

Contaminants in sediment may partition into pore water, making them available to submerged roots.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Aquatic Plants/Emergent Vegetation:**

**Provide explanation:**

**Question T:**

Could contaminants bioconcentrate in sedimentary or water-column organisms?

Aquatic receptors may actively or incidentally ingest sediment while foraging.

Aquatic receptors may be directly exposed to contaminated sediments or may be exposed to contaminants through osmotic exchange, respiration, or ventilation of sediment pore waters.

Aquatic receptors may be exposed through osmotic exchange, respiration, or ventilation of surface waters.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Aquatic Animals:**

**Provide explanation:**



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**Question U:**

Could contaminants bioaccumulate in sedimentary or water column organisms?

Lipophilic organic contaminants and some metals may concentrate in an organism's tissues.

Ingestion of contaminated food items may result in contaminant bioaccumulation through the food web.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

**Aquatic Animals:**

**Provide explanation:**

**Question V:**

Could contaminants interact with aquatic plants or animals through external irradiation?

External irradiation effects are most relevant for gamma-emitting radionuclides.

The water column acts to absorb radiation; therefore, external irradiation is typically more important for sediment dwelling organisms.

**Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):**

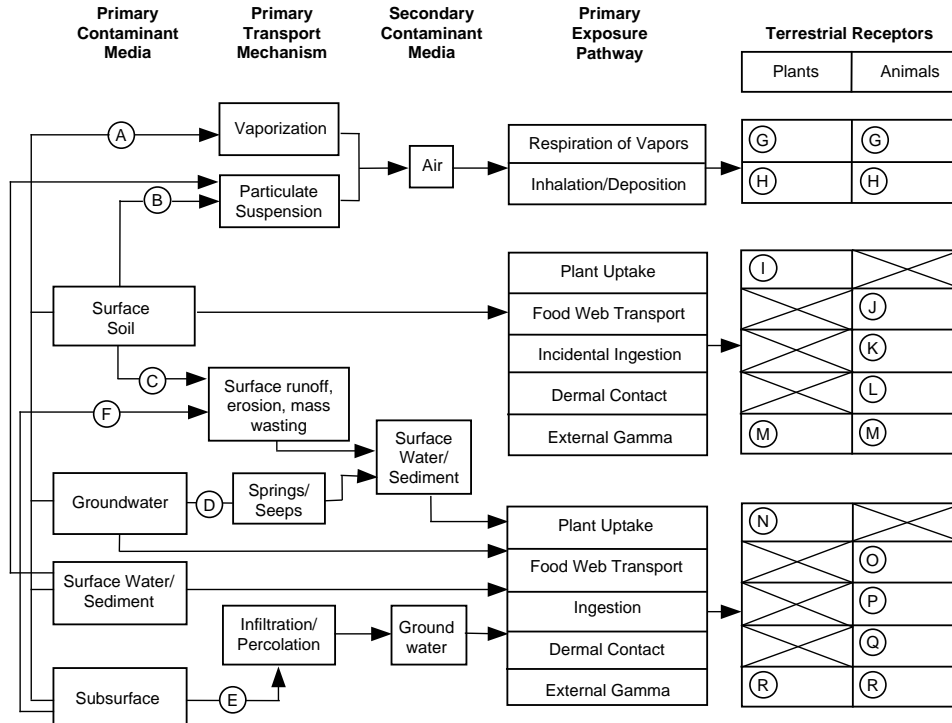
**Aquatic Plants:**

**Aquatic Animals:**

**Provide explanation:**

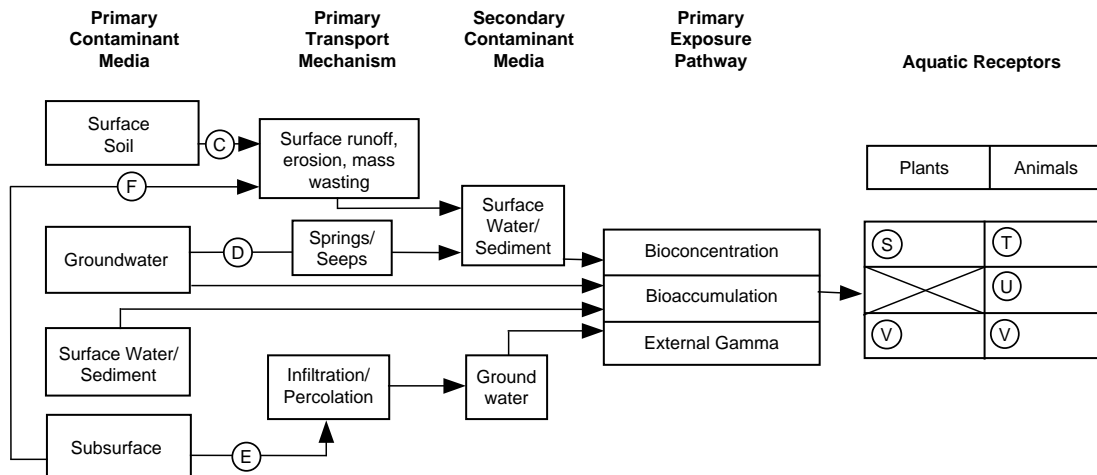
**Ecological Scoping Checklist  
Terrestrial Receptors  
Ecological Pathways Conceptual Exposure Model**

**NOTE:**  
Letters in circles refer to questions on the Scoping Checklist



**Ecological Scoping Checklist  
Aquatic Receptors  
Ecological Pathways Conceptual Exposure Model**

**NOTE:**  
Letters in circles refer to questions on the Scoping Checklist



**Signatures and certifications:**

**Checklist completed by (provide name, organization and phone number):**

**Name (printed):** \_\_\_\_\_

**Name (signature):** \_\_\_\_\_

**Organization:** \_\_\_\_\_

**Phone number:** \_\_\_\_\_

**Date completed:** \_\_\_\_\_

**Verification by another party (provide name, organization and phone number):**

**Name (printed):** \_\_\_\_\_

**Name (signature):** \_\_\_\_\_

**Organization:** \_\_\_\_\_

**Phone number:** \_\_\_\_\_