```
diary on         % begin recording

% FEMA appeal for The Town of Harpswell, Cumberland county, Maine
% TRANSECT ID: CM-53-1
% calculation by SJH, Ransom Consulting, Inc. 16-Apr-2020
% 100-year wave runup using TAW methodology
% including berm and weighted average with foreshore if necessary
%
% chk nld 20200220
%
% This script assumes that the incident wave conditions provided
% as input in the configuration section below are the
% appropriate values located at the end of the foreshore
% or toe of the slope on which the run-up is being calculated
% the script does not attempt to apply a depth limit or any other
% transformation to the incident wave conditions other than
% conversion of the peak wave period to the spectral mean wave
% as recommended in the references below
%
% references:
%
% Van der Meer, J.W., 2002. Technical Report Wave Run-up and
% Wave Overtopping at Dikes. TAW Technical Advisory Committee on
% Flood Defence, The Netherlands.
%
% FEMA. 2007,  Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update
%
%
%

%-------------------------------------------------------------------------
% CONFIG
%-------------------------------------------------------------------------
fname='inpfiles/CM-53-1sta_ele_include.csv';   % file with station, elevation, include
                                    % third colunm is 0 for excluded points
imgname='logfiles/CM-53-1-runup';
SWEL=9.0727;  % 100-yr still water level including wave setup.
H0=1.7049;    % significant wave height at toe of structure
Tp=8.0957;    % peak period, 1/fma,
T0=Tp/1.1;

gamma_berm=1;   % this may get changed automatically below
gamma_rough=0.8;
gamma_beta=1;
gamma_perm=1;

setupAtToe=-0.0015879;
maxSetup=0.3469;   % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for CM-53-1'

plotTitle =

Iterative TAW for CM-53-1



% END CONFIG
%------------------------------

SWEL=SWEL+setupAtToe

SWEL =

                 9.0711121

SWEL_fore=SWEL+maxSetup

SWEL_fore =

                 9.4180121



% FIND WAVELENGTH USING DEEPWATER DISPERSION RELATION
% using English units
L0=32.15/(2*pi)*T0^2

L0 =

           277.15616993901


% Find Hb (Munk, 1949)
%Hb=H0/(3.3*(H0/L0)^(1/3))
%Db=-Hb/.78+SWEL;  % depth at breaking

% The toe elevation here is only used to determine the average
% structure slope, it is not used to depth limit the wave height.
% Any depth limiting or other modification of the wave height
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% to make it consitent with TAW guidance should be performed
% prior to the input of the significant wave height given above.
Ztoe=SWEL-1.5*H0

Ztoe =

                 6.5137621


% read the transect
[sta,dep,inc] = textread(fname,'%n%n%n%*[^\n]','delimiter',',','headerlines',0);

% remove unselected points
k=find(inc==0);
sta(k)=[];
dep(k)=[];

sta_org=sta;  % used for plotting purposes
dep_org=dep;


% initial guess at maximum run-up elevation to estimate slope
Z2=SWEL+1.5*H0

Z2 =

               11.6284621


% determine station at the max runup and -1.5*H0 (i.e. the toe)
top_sta=-999;
toe_sta=-999;
for kk=1:length(sta)-1
    if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1)))    % here is the intersection of z2 with profile
       top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
    end
    if  ((Ztoe > dep(kk)) & (Ztoe <= dep(kk+1)))    % here is the intersection of Ztoe with profile
       toe_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Ztoe)
    end
end

toe_sta =

          45.4148854748707


top_sta =

          73.3447743281279

% check to make sure we got them, if not extend the end slopes outward
S=diff(dep)./diff(sta);
if toe_sta==-999
   dy=dep(1)-Ztoe;
   toe_sta=sta(1)-dy/S(1)
end
if top_sta==-999
   dy=Z2-dep(end);
   top_sta=sta(end)+dy/S(end)
end

% just so the reader can tell the values aren't -999 anymore
top_sta

top_sta =

          73.3447743281279

toe_sta

toe_sta =

          45.4148854748707




% check for case where the toe of slope is below SWL-1.5*H0
% in this case interpolate setup from the setupAtToe(really setup as first station), and the max setup
% also un-include points seaward of SWL-1.5*H0
if Ztoe > dep(1)
   dd=SWEL_fore-dep;
   k=find(dd<0,1); % k is index of first land point
   staAtSWL=interp1(dep(k-1:k),sta(k-1:k),SWEL_fore);
   dsta=staAtSWL-sta(1);
   dsetup=maxSetup-setupAtToe;
   dsetdsta=dsetup/dsta;
   setup=setupAtToe+dsetdsta*(toe_sta-sta(1));
   sprintf('-!!- Location of SWEL-1.5*H0 is %4.1f ft landward of toe of slope',dsta)
   sprintf('-!!- Setup is interpolated between setup at toe of slope and max setup')
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   sprintf('-!!-       setup is adjusted to %4.2f feet',setup)
   SWEL=SWEL-setupAtToe+setup;
   sprintf('-!!-       SWEL is adjusted to %4.2f feet',SWEL)
   k=find(dep < SWEL-1.5*H0)
   sta(k)=[];
   dep(k)=[];
else
   sprintf('-!!- The User has selected a starting point that is %4.2f feet above the elevation of SWEL-1.5H0\n',dep(1
   sprintf('-!!- This may be reasonable for some cases.  However the user may want to consider:\n')
   sprintf('-!!-   1) Selecting a starting point that is at or below %4.2f feet elevation, or\n', Ztoe)
   sprintf('-!!-   2) Reducing the incident wave height to a depth limited condition.\n')
end

ans =

-!!- Location of SWEL-1.5*H0 is 105.0 ft landward of toe of slope


ans =

-!!- Setup is interpolated between setup at toe of slope and max setup


ans =

-!!-       setup is adjusted to 0.31 feet


ans =

-!!-       SWEL is adjusted to 9.38 feet


k =

     1
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     4
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```
% now iterate converge on a runup elevation
tol=0.01;  % convergence criteria
R2del=999;
R2_new=3*H0; %initial guess
R2=R2_new;
iter=0;
R2_all=[];
topStaAll=[];
Berm_Segs=[];
TAW_ALWAYS_VALID=1;
while(abs(R2del) > tol && iter <= 25)
    iter=iter+1;
    sprintf ('!----------------- STARTING ITERATION %d -----------------!',iter)
    % elevation of toe of slope
    Ztoe
    % station of toe slope (relative to 0-NAVD88 shoreline
    toe_sta
    % station of top of slope/extent of 2% run-up
    top_sta
    % elevation of top of slope/extent of 2% run-up
    Z2
    % incident significant wave height
    H0
    % incident spectral peak wave period
    Tp
    % incident spectral mean wave period
    T0

    R2=R2_new
    Z2=R2+SWEL
    % determine slope for this iteration
    top_sta=-999;
    for kk=1:length(sta)-1
       if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1)))    % here is the intersection of z2 with profile
          top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
          break;
       end
    end
    if top_sta==-999
       dy=Z2-dep(end);
       top_sta=sta(end)+dy/S(end)
    end

    % get the length of the slope (not accounting for berm)
    Lslope=top_sta-toe_sta

    % loop over profile segments to determine berm factor
```

```
% re-calculate influence of depth of berm based on this run-up elevation
% check for berm, berm width, berm height
berm_width=0;
rdh_sum=0;
Berm_Segs=[];
Berm_Heights=[];
for kk=1:length(sta)-1
   ddep=dep(kk+1)-dep(kk);
   dsta=sta(kk+1)-sta(kk);
   s=ddep/dsta;
   if  (s < 1/15)     % count it as a berm if slope is flatter than 1:15 (see TAW manual)
      sprintf ('Berm Factor Calculation: Iteration %d, Profile Segment: %d',iter,kk)
      berm_width=berm_width+dsta;   % tally the width of all berm segments
      % compute the rdh for this segment and weight it by the segment length
      dh=SWEL-(dep(kk)+dep(kk+1))/2
      if  dh < 0
          chi=R2;
      else
          chi=2* H0;
      end
      if (dh <= R2 & dh >=-2*H0)
         rdh=(0.5-0.5*cos(3.14159*dh/chi)) ;
      else
         rdh=1;
      end
      rdh_sum=rdh_sum + rdh * dsta
      Berm_Segs=[Berm_Segs, kk];
      Berm_Heights=[Berm_Heights, (dep(kk)+dep(kk+1))/2];
   end
   if dep(kk) >= Z2  % jump out of loop if we reached limit of run-up for this iteration
      break
   end
end
sprintf ('!------- End Berm Factor Calculation, Iter: %d ---------!',iter)
berm_width
rB=berm_width/Lslope
if (berm_width > 0)
   rdh_mean=rdh_sum/berm_width
else
   rdh_mean=1
end
gamma_berm=1- rB * (1-rdh_mean)
if gamma_berm > 1
   gamma_berm=1
end
if gamma_berm < 0.6
   gamma_berm =0.6
end
% Iribarren number
slope=(Z2-Ztoe)/(Lslope-berm_width)
Irb=(slope/(sqrt(H0/L0)))
% runup height
gamma_berm
gamma_perm
gamma_beta
gamma_rough
gamma=gamma_berm*gamma_perm*gamma_beta*gamma_rough
% check validity
TAW_VALID=1;
if (Irb*gamma_berm < 0.5 | Irb*gamma_berm > 10 )
   sprintf('!!! - - Iribaren number: %6.2f is outside the valid range (0.5-10), TAW NOT VALID - - !!!\n', Irb*gam
   TAW_VALID=0;
else
   sprintf('!!! - - Iribaren number: %6.2f is in the valid range (0.5-10), TAW RECOMMENDED - - !!!\n', Irb*gamma_
end
islope=1/slope;
if (slope < 1/8 | slope > 1)
   sprintf('!!! - - slope: 1:%3.1f V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!\n', islope)
   TAW_VALID=0;
else
   sprintf('!!! - - slope: 1:%3.1f V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!\n', islope)
end
if TAW_VALID == 0
   TAW_ALWAYS_VALID=0;
end

if (Irb*gamma_berm < 1.8)
   R2_new=gamma*H0*1.77*Irb
else
   R2_new=gamma*H0*(4.3-(1.6/sqrt(Irb)))
end
% check to see if we need to evaluate a shallow foreshore
if berm_width > 0.25 * L0;
   disp ('!   Berm_width is greater than 1/4 wave length')
   disp ('!   Runup will be weighted average with foreshore calculation assuming depth limited wave height on ber
   % do the foreshore calculation
   fore_H0=0.78*(SWEL_fore-min(Berm_Heights))
   % get upper slope
   fore_toe_sta=-999;
   fore_toe_dep=-999;
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       for kk=length(dep)-1:-1:1
          ddep=dep(kk+1)-dep(kk);
          dsta=sta(kk+1)-sta(kk);
          s=ddep/dsta;
          if s < 1/15
             break
          end
          fore_toe_sta=sta(kk);
          fore_toe_dep=dep(kk);
          upper_slope=(Z2-fore_toe_dep)/(top_sta-fore_toe_sta)
       end
       fore_Irb=upper_slope/(sqrt(fore_H0/L0));
       fore_gamma=gamma_perm*gamma_beta*gamma_rough;
       if (fore_Irb < 1.8)
          fore_R2=fore_gamma*fore_H0*1.77*fore_Irb;
       else
          fore_R2=fore_gamma*fore_H0*(4.3-(1.6/sqrt(fore_Irb)));
       end
       if berm_width >= L0
          R2_new=fore_R2
          disp ('berm is wider than one wavelength, use full shallow foreshore solution');
       else
          w2=(berm_width-0.25*L0)/(0.75*L0)
          w1=1-w2
          R2_new=w2*fore_R2 + w1*R2_new
       end
    end % end berm width check
    % convergence criterion
    R2del=abs(R2-R2_new)
    R2_all(iter)=R2_new;
    % get the new top station (for plot purposes)
    Z2=R2_new+SWEL
    top_sta=-999;
    for kk=1:length(sta)-1
       if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1)))    % here is the intersection of z2 with profile
          top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
          break;
       end
    end
    if top_sta==-999
       dy=Z2-dep(end);
       top_sta=sta(end)+dy/S(end);
    end
    topStaAll(iter)=top_sta;
end
ans =
!----------------- STARTING ITERATION 1 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          73.3447743281279
Z2 =
               11.6284621
H0 =
                   1.7049
Tp =
                   8.0957
T0 =
          7.35972727272727
R2 =
                   5.1147
Z2 =
          14.4924632098631
top_sta =
          567.338591721866
Lslope =
          521.923706246995
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
         0.549552760497199
ans =
!------- End Berm Factor Calculation, Iter: 1 ---------!
berm_width =
     1
rB =
       0.00191598884670466
rdh_mean =
          0.549552760497199
gamma_berm =
          0.999136948113084
slope =
        0.0153164484821506
Irb =
          0.195285903188763
gamma_berm =
```

```
         0.999136948113084
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
         0.799309558490467
ans =
!!! - - Iribaren number:   0.20 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:65.3 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
         0.471040314472975
R2del =
          4.64365968552702
Z2 =
          9.84880352433604
top_sta =
          59.9998005163601
ans =
!----------------- STARTING ITERATION 2 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          59.9998005163601
Z2 =
          9.84880352433604
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
         0.471040314472975
Z2 =
          9.84880352433604
top_sta =
          59.9998005163601
Lslope =
          14.5849150414894
ans =
!------- End Berm Factor Calculation, Iter: 2 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
         0.228663753943641
Irb =
          2.91548055461138
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
                       0.8
ans =
!!! - - Iribaren number:   2.92 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
           4.5867884572374
R2del =
          4.11574814276443
Z2 =
          13.9645516671005
ans =
!----------------- STARTING ITERATION 3 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          460.061301991597
Z2 =
          13.9645516671005
H0 =
```

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                    1.7049
Tp =
                    8.0957
T0 =
           7.35972727272727
R2 =
            4.5867884572374
Z2 =
           13.9645516671005
top_sta =
           460.061301991597
Lslope =
           414.646416516726
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 34
dh =
          -2.71896729013694
rdh_sum =
           0.643686401932612
ans =
!------- End Berm Factor Calculation, Iter: 3 ---------!
berm_width =
     1
rB =
       0.00241169333718253
rdh_mean =
           0.643686401932612
gamma_berm =
           0.999140680869593
slope =
         0.0180124600857002
Irb =
           0.229660259725798
gamma_berm =
           0.999140680869593
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
           0.799312544695675
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
           0.553955218232992
R2del =
            4.03283323900441
Z2 =
            9.93171842809605
top_sta =
           60.3802453317674
ans =
!------------------ STARTING ITERATION 4 -----------------!
Ztoe =
                  6.5137621
toe_sta =
           45.4148854748707
top_sta =
           60.3802453317674
Z2 =
           9.93171842809605
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
           7.35972727272727
R2 =
          0.553955218232992
Z2 =
           9.93171842809605
top_sta =
           60.3802453317674
Lslope =
           14.9653598568967
ans =
!------- End Berm Factor Calculation, Iter: 4 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
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```
         0.228391188770574
Irb =
          2.91200532756626
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
                       0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602605297957
R2del =
          4.03207083474657
Z2 =
          13.9637892628426
ans =
!----------------- STARTING ITERATION 5 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906373266168
Z2 =
          13.9637892628426
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          4.58602605297957
Z2 =
          13.9637892628426
top_sta =
          459.906373266168
Lslope =
          414.491487791297
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
          0.643834662876749
ans =
!------- End Berm Factor Calculation, Iter: 5 ---------!
berm_width =
     1
rB =
        0.0024125947804832
rdh_mean =
          0.643834662876749
gamma_berm =
          0.999140717366667
slope =
        0.0180173652488897
Irb =
          0.229722800935979
gamma_berm =
          0.999140717366667
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
          0.799312573893334
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
          0.554106091868018
R2del =
           4.03191996111155
Z2 =
           9.93186930173108
top_sta =
           60.3809375968426
ans =
```

```
!----------------- STARTING ITERATION 6 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809375968426
Z2 =
          9.93186930173108
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
         0.554106091868018
Z2 =
          9.93186930173108
top_sta =
          60.3809375968426
Lslope =
          14.9660521219719
ans =
!------- End Berm Factor Calculation, Iter: 6 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
         0.228390705436132
Irb =
          2.91199916501473
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                      0.8
gamma =
                      0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602469981103
R2del =
          4.03191860794301
Z2 =
          13.9637879096741
ans =
!----------------- STARTING ITERATION 7 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906098287803
Z2 =
          13.9637879096741
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          4.58602469981103
Z2 =
          13.9637879096741
top_sta =
          459.906098287803
Lslope =
          414.491212812932
ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
         0.643834926052238
ans =
!------- End Berm Factor Calculation, Iter: 7 ---------!
berm_width =
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```
     1
rB =
       0.00241259638102707
rdh_mean =
          0.643834926052238
gamma_berm =
          0.999140717431545
slope =
        0.0180173739581851
Irb =
          0.229722911980169
gamma_berm =
          0.999140717431545
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
          0.799312573945236
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
          0.554106359749687
R2del =
           4.03191834006134
Z2 =
           9.93186956961275
top_sta =
           60.3809388259846
ans =
!----------------- STARTING ITERATION 8 -----------------!
Ztoe =
                  6.5137621
toe_sta =
           45.4148854748707
top_sta =
           60.3809388259846
Z2 =
           9.93186956961275
H0 =
                     1.7049
Tp =
                     8.0957
T0 =
           7.35972727272727
R2 =
          0.554106359749687
Z2 =
           9.93186956961275
top_sta =
           60.3809388259846
Lslope =
           14.9660533511139
ans =
!------- End Berm Factor Calculation, Iter: 8 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
          0.228390704577994
Irb =
            2.9119991540734
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
                        0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
           4.58602469740854
R2del =
           4.03191833765885
Z2 =
```

```
          13.9637879072716
ans =
!----------------- STARTING ITERATION 9 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906097799591
Z2 =
          13.9637879072716
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          4.58602469740854
Z2 =
          13.9637879072716
top_sta =
          459.906097799591
Lslope =
           414.49121232472
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
          0.643834926519495
ans =
!------- End Berm Factor Calculation, Iter: 9 ---------!
berm_width =
     1
rB =
       0.00241259638386877
rdh_mean =
          0.643834926519495
gamma_berm =
          0.999140717431661
slope =
        0.0180173739736481
Irb =
          0.229722912177323
gamma_berm =
          0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
          0.799312573945329
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
           0.5541063602253
R2del =
          4.03191833718324
Z2 =
          9.93186957008836
top_sta =
          60.3809388281669
ans =
!----------------- STARTING ITERATION 10 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809388281669
Z2 =
          9.93186957008836
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
           0.5541063602253
Z2 =
          9.93186957008836
top_sta =
          60.3809388281669
Lslope =
```

```
          14.9660533532962
ans =
!------- End Berm Factor Calculation, Iter: 10 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
          0.22839070457647
Irb =
          2.91199915405397
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
                        0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602469740427
R2del =
          4.03191833717897
Z2 =
          13.9637879072673
ans =
!----------------- STARTING ITERATION 11 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906097798724
Z2 =
          13.9637879072673
H0 =
                     1.7049
Tp =
                     8.0957
T0 =
          7.35972727272727
R2 =
          4.58602469740427
Z2 =
          13.9637879072673
top_sta =
          459.906097798724
Lslope =
          414.491212323853
ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
         0.643834926520324
ans =
!------- End Berm Factor Calculation, Iter: 11 ---------!
berm_width =
     1
rB =
       0.00241259638387381
rdh_mean =
         0.643834926520324
gamma_berm =
         0.999140717431661
slope =
        0.0180173739736755
Irb =
          0.229722912177673
gamma_berm =
          0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
          0.799312573945329
ans =
```

```
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
         0.554106360226144
R2del =
          4.03191833717813
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
ans =
!----------------- STARTING ITERATION 12 -----------------!
Ztoe =
                 6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809388281708
Z2 =
          9.93186957008921
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
         0.554106360226144
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
Lslope =
          14.9660533533001
ans =
!------- End Berm Factor Calculation, Iter: 12 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
         0.228390704576467
Irb =
          2.91199915405394
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                      0.8
gamma =
                      0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602469740427
R2del =
          4.03191833717812
Z2 =
          13.9637879072673
ans =
!----------------- STARTING ITERATION 13 -----------------!
Ztoe =
                 6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906097798722
Z2 =
          13.9637879072673
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          4.58602469740427
Z2 =
          13.9637879072673
top_sta =
```

```
          459.906097798722
Lslope =
          414.491212323851
ans =
Berm Factor Calculation: Iteration 13, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
         0.643834926520326
ans =
!------- End Berm Factor Calculation, Iter: 13 ---------!
berm_width =
     1
rB =
       0.00241259638387382
rdh_mean =
         0.643834926520326
gamma_berm =
         0.999140717431661
slope =
        0.0180173739736756
Irb =
         0.229722912177674
gamma_berm =
         0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
         0.799312573945329
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
         0.554106360226146
R2del =
          4.03191833717812
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
ans =
!----------------- STARTING ITERATION 14 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809388281708
Z2 =
          9.93186957008921
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
         0.554106360226146
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
Lslope =
          14.9660533533001
ans =
!------- End Berm Factor Calculation, Iter: 14 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
         0.228390704576467
Irb =
          2.91199915405394
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
```

```
                    0.8
gamma =
                    0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
         4.58602469740427
R2del =
         4.03191833717812
Z2 =
         13.9637879072673
ans =
!----------------- STARTING ITERATION 15 -----------------!
Ztoe =
               6.5137621
toe_sta =
         45.4148854748707
top_sta =
         459.906097798722
Z2 =
         13.9637879072673
H0 =
                  1.7049
Tp =
                  8.0957
T0 =
         7.35972727272727
R2 =
         4.58602469740427
Z2 =
         13.9637879072673
top_sta =
         459.906097798722
Lslope =
         414.491212323852
ans =
Berm Factor Calculation: Iteration 15, Profile Segment: 34
dh =
        -2.71896729013694
rdh_sum =
         0.643834926520326
ans =
!------- End Berm Factor Calculation, Iter: 15 ---------!
berm_width =
     1
rB =
       0.00241259638387382
rdh_mean =
         0.643834926520326
gamma_berm =
         0.999140717431661
slope =
        0.0180173739736756
Irb =
         0.229722912177674
gamma_berm =
         0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                    0.8
gamma =
         0.799312573945329
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
         0.554106360226146
R2del =
          4.03191833717812
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
ans =
!----------------- STARTING ITERATION 16 -----------------!
Ztoe =
               6.5137621
toe_sta =
         45.4148854748707
top_sta =
         60.3809388281708
Z2 =
         9.93186957008921
H0 =
```

```
                    1.7049
Tp =
                    8.0957
T0 =
           7.35972727272727
R2 =
          0.554106360226146
Z2 =
           9.93186957008921
top_sta =
           60.3809388281708
Lslope =
           14.9660533533001
ans =
!------- End Berm Factor Calculation, Iter: 16 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
          0.228390704576467
Irb =
           2.91199915405394
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
                        0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
           4.58602469740427
R2del =
           4.03191833717812
Z2 =
           13.9637879072673
ans =
!----------------- STARTING ITERATION 17 -----------------!
Ztoe =
                  6.5137621
toe_sta =
           45.4148854748707
top_sta =
           459.906097798722
Z2 =
           13.9637879072673
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
           7.35972727272727
R2 =
           4.58602469740427
Z2 =
           13.9637879072673
top_sta =
           459.906097798722
Lslope =
           414.491212323851
ans =
Berm Factor Calculation: Iteration 17, Profile Segment: 34
dh =
          -2.71896729013694
rdh_sum =
          0.643834926520326
ans =
!------- End Berm Factor Calculation, Iter: 17 ---------!
berm_width =
     1
rB =
       0.00241259638387382
rdh_mean =
          0.643834926520326
gamma_berm =
          0.999140717431661
slope =
         0.0180173739736756
Irb =
```

```
         0.229722912177674
gamma_berm =
         0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
         0.799312573945329
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
         0.554106360226146
R2del =
          4.03191833717812
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
ans =
!----------------- STARTING ITERATION 18 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809388281708
Z2 =
          9.93186957008921
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
         0.554106360226146
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
Lslope =
          14.9660533533001
ans =
!------- End Berm Factor Calculation, Iter: 18 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
         0.228390704576467
Irb =
          2.91199915405394
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
                       0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602469740427
R2del =
          4.03191833717812
Z2 =
          13.9637879072673
ans =
!----------------- STARTING ITERATION 19 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906097798722
Z2 =
```

```
          13.9637879072673
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          4.58602469740427
Z2 =
          13.9637879072673
top_sta =
          459.906097798722
Lslope =
          414.491212323852
ans =
Berm Factor Calculation: Iteration 19, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
          0.643834926520326
ans =
!------- End Berm Factor Calculation, Iter: 19 ---------!
berm_width =
     1
rB =
       0.00241259638387382
rdh_mean =
          0.643834926520326
gamma_berm =
          0.999140717431661
slope =
        0.0180173739736756
Irb =
          0.229722912177674
gamma_berm =
          0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
          0.799312573945329
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
          0.554106360226146
R2del =
           4.03191833717812
Z2 =
           9.93186957008921
top_sta =
          60.3809388281708
ans =
!----------------- STARTING ITERATION 20 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809388281708
Z2 =
          9.93186957008921
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          0.554106360226146
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
Lslope =
          14.9660533533001
ans =
!------- End Berm Factor Calculation, Iter: 20 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
```

```
     1
slope =
         0.228390704576467
Irb =
          2.91199915405394
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
                       0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602469740427
R2del =
          4.03191833717812
Z2 =
          13.9637879072673
ans =
!----------------- STARTING ITERATION 21 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906097798722
Z2 =
          13.9637879072673
H0 =
                     1.7049
Tp =
                     8.0957
T0 =
          7.35972727272727
R2 =
          4.58602469740427
Z2 =
          13.9637879072673
top_sta =
          459.906097798722
Lslope =
          414.491212323851
ans =
Berm Factor Calculation: Iteration 21, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
         0.643834926520326
ans =
!------- End Berm Factor Calculation, Iter: 21 ---------!
berm_width =
     1
rB =
       0.00241259638387382
rdh_mean =
          0.643834926520326
gamma_berm =
          0.999140717431661
slope =
         0.0180173739736756
Irb =
          0.229722912177674
gamma_berm =
          0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
          0.799312573945329
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
          0.554106360226146
R2del =
          4.03191833717812
Z2 =
          9.93186957008921
top_sta =
```

```
          60.3809388281708
ans =
!----------------- STARTING ITERATION 22 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809388281708
Z2 =
          9.93186957008921
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
         0.554106360226146
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
Lslope =
          14.9660533533001
ans =
!------- End Berm Factor Calculation, Iter: 22 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
         0.228390704576467
Irb =
          2.91199915405394
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
                        0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602469740427
R2del =
          4.03191833717812
Z2 =
          13.9637879072673
ans =
!----------------- STARTING ITERATION 23 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906097798722
Z2 =
          13.9637879072673
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          4.58602469740427
Z2 =
          13.9637879072673
top_sta =
          459.906097798722
Lslope =
          414.491212323852
ans =
Berm Factor Calculation: Iteration 23, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
         0.643834926520326
ans =
```

```
!------- End Berm Factor Calculation, Iter: 23 ---------!
berm_width =
     1
rB =
       0.00241259638387382
rdh_mean =
         0.643834926520326
gamma_berm =
         0.999140717431661
slope =
        0.0180173739736756
Irb =
         0.229722912177674
gamma_berm =
         0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
         0.799312573945329
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
         0.554106360226146
R2del =
          4.03191833717812
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
ans =
!----------------- STARTING ITERATION 24 -----------------!
Ztoe =
                6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809388281708
Z2 =
          9.93186957008921
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
         0.554106360226146
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
Lslope =
          14.9660533533001
ans =
!------- End Berm Factor Calculation, Iter: 24 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
         0.228390704576467
Irb =
          2.91199915405394
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
                       0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602469740427
R2del =
```

```
          4.03191833717812
Z2 =
          13.9637879072673
ans =
!----------------- STARTING ITERATION 25 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          459.906097798722
Z2 =
          13.9637879072673
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          4.58602469740427
Z2 =
          13.9637879072673
top_sta =
          459.906097798722
Lslope =
          414.491212323851
ans =
Berm Factor Calculation: Iteration 25, Profile Segment: 34
dh =
         -2.71896729013694
rdh_sum =
          0.643834926520326
ans =
!------- End Berm Factor Calculation, Iter: 25 ---------!
berm_width =
     1
rB =
       0.00241259638387382
rdh_mean =
          0.643834926520326
gamma_berm =
          0.999140717431661
slope =
        0.0180173739736756
Irb =
          0.229722912177674
gamma_berm =
          0.999140717431661
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
          0.799312573945329
ans =
!!! - - Iribaren number:   0.23 is outside the valid range (0.5-10), TAW NOT VALID - - !!!
ans =
!!! - - slope: 1:55.5 V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!
R2_new =
          0.554106360226146
R2del =
          4.03191833717812
Z2 =
          9.93186957008921
top_sta =
          60.3809388281708
ans =
!----------------- STARTING ITERATION 26 -----------------!
Ztoe =
                  6.5137621
toe_sta =
          45.4148854748707
top_sta =
          60.3809388281708
Z2 =
          9.93186957008921
H0 =
                    1.7049
Tp =
                    8.0957
T0 =
          7.35972727272727
R2 =
          0.554106360226146
Z2 =
          9.93186957008921
top_sta =
```

```
          60.3809388281708
Lslope =
          14.9660533533001
ans =
!------- End Berm Factor Calculation, Iter: 26 ---------!
berm_width =
     0
rB =
     0
rdh_mean =
     1
gamma_berm =
     1
slope =
         0.228390704576467
Irb =
          2.91199915405394
gamma_berm =
     1
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
                       0.8
ans =
!!! - - Iribaren number:   2.91 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.58602469740427
R2del =
          4.03191833717812
Z2 =
          13.9637879072673
% final 2% runup elevation
Z2=R2_new+SWEL
Z2 =
          13.9637879072673
diary off
-1.000000e+00
```